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NOVEMBER
1937

factory

Management and Maintenance

A Case in British Labor Relations
The Variable Budget
What Instruments Are Doing

McGRAW-HILL PUBLISHING COMPANY, INC.

9371

"By the way, Jim, get in touch with the STANDARD LUBRICATION ENGINEER . . .

he saved us money on that last installation"

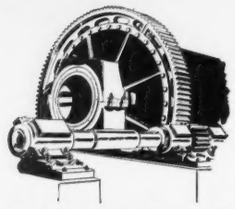
Plant alterations or additions and the installation of new equipment require considerable planning and forethought. Building design, equipment layout, production flow are determined before any part of the work is started. Architects, equipment erectors and many other specialists outside your organization are called in for consultation. And in this stage of the operation, that other specialist, the Standard Lubrication Engineer, can be consulted with real advantage to you.

In most instances the changes involve problems in lubrication. Additional units will increase power demands. Increased production in one department may throw an added burden on existing equipment in another. From the power plant to the furthermost line shaft or motor, lubrication should be checked and lubricants stocked to handle the new conditions.

Start right. Plan for lubrication as you plan other plant changes. Call an expert on lubrication—the Standard Lubrication Engineer. Let him study your problem before operations begin.

Start now by getting acquainted with your Standard Lubrication Engineer. Call him at your local Standard Oil office. You'll find his service willing, helpful and free.

Copr. 1937, Standard Oil Co.



STOCK GREASES WITH SPECIAL FORMULA QUALITIES

Superla Greases were developed to simplify lubrication and reduce costs by providing an easily identified, high quality product for a wide range of uses. Seven grades of Superla Greases are available. Made to exacting standards of consistency they provide the correct lubricant for many types of bearings, gears or chain drives, operating at various speeds and temperatures, and for all usual methods of application.

By combining the highest grade ingredients with laboratory control of manufacture, Superla Greases are unfailingly consistent in quality. They are clean and free from grit and corrosive substances. Special stocks, including higher viscosity oils used in their manufacture, provide a tougher, long lasting lubricating film.

Many of the inherent qualities of the Superla Greases could only be obtained in the past with special-formula greases. Now in Superla they are readily available anywhere in Standard Oil (Indiana) territory.

THE RIGHT LUBRICANT • PROPERLY APPLIED • TO REDUCE COSTS

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING

MEN TRIED JUST AS HARD TO TIE BELT ENDS TOGETHER

A typical example of Goodrich development in rubber

GROWN men, trained engineers, tried to fasten belt ends together —and for many years their splices were as apt to come apart as the little fellow's shoestrings.

Some belts could be laced up or held with metal fasteners but those high-tension belts on heavy machines, or high-speed belts running a mile a minute, or more, failed at the splices with discouraging regularity. Goodrich research men, already busy with other improvements in belting, took this as the problem of the year.

They found failures came not so much from *weak* splices as from tension and air resistance. Even the thinnest feather-edge of fabric would be loosened by repeated flexing and air currents; then the belt plies would separate. So they designed a splice in which a section of an inner ply is removed, the outer ply carried under the surface, covered, sealed with rubber and vulcanized in a portable electric vulcanizer. Belts with this new "Ply-lock" splice lasted sometimes ten times as long as the old belts. Users constantly tell us of serious belt problems which have been completely solved.

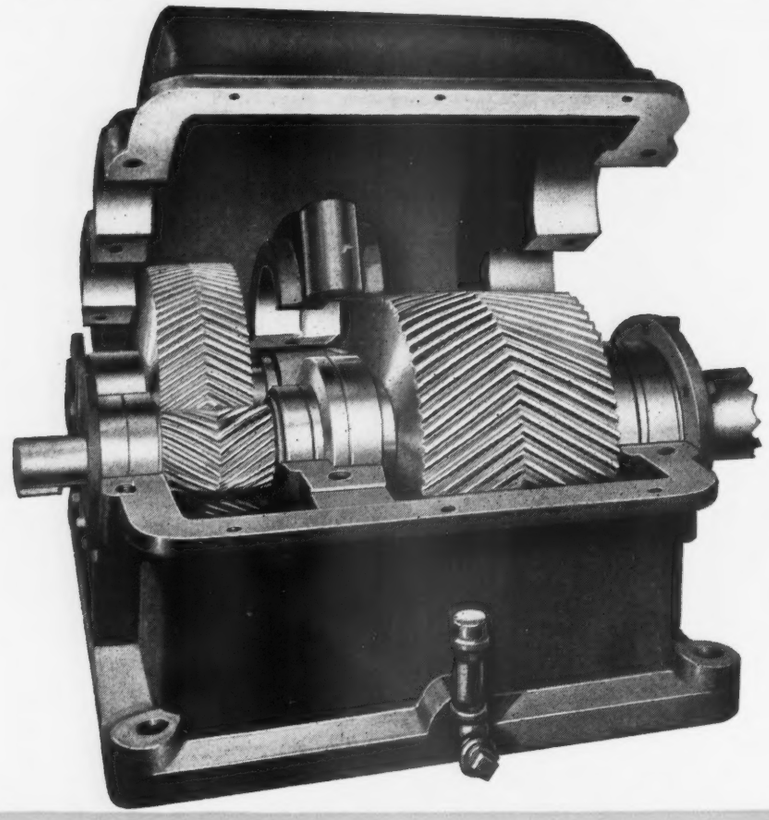
Goodrich is always busy with development work on rubber products. Much of it applies to new products, new uses—but no product is too "staple" or too *standardized* to get its share of this work. Goodrich research in rubber has resulted in important improvements in conveyor belts, rubber-lined pipe, steam hose, suction hose and hundreds of other products classed generally as mechanical rubber goods. Ask your Goodrich distributor about them. Write us if you don't know him. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* IN RUBBER

Another story of Goodrich development work appears on the page facing the third cover.

LINK-BELT



HERRINGBONE GEAR REDUCER

● Precision built and engineered — dependable, silent, durable — the Link-Belt Herringbone Gear Reducer is a worthy member of the Link-Belt positive drive group, which includes also reducers of the Worm and Motorized Helical Gear types, Silent and Roller Chain Drives, and Variable Speed Transmissions.

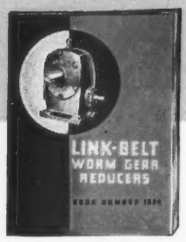
It is fully enclosed, compact, self-contained — built in a variety of sizes in single, double and triple reductions, in a large range of ratios and horse powers. Ability to withstand shock loads and conservation of space are outstanding qualities of this unit.

Link-Belt Company, Philadelphia, Chicago, Indianapolis, Atlanta, San Francisco and Toronto. Offices in principal cities. 7074

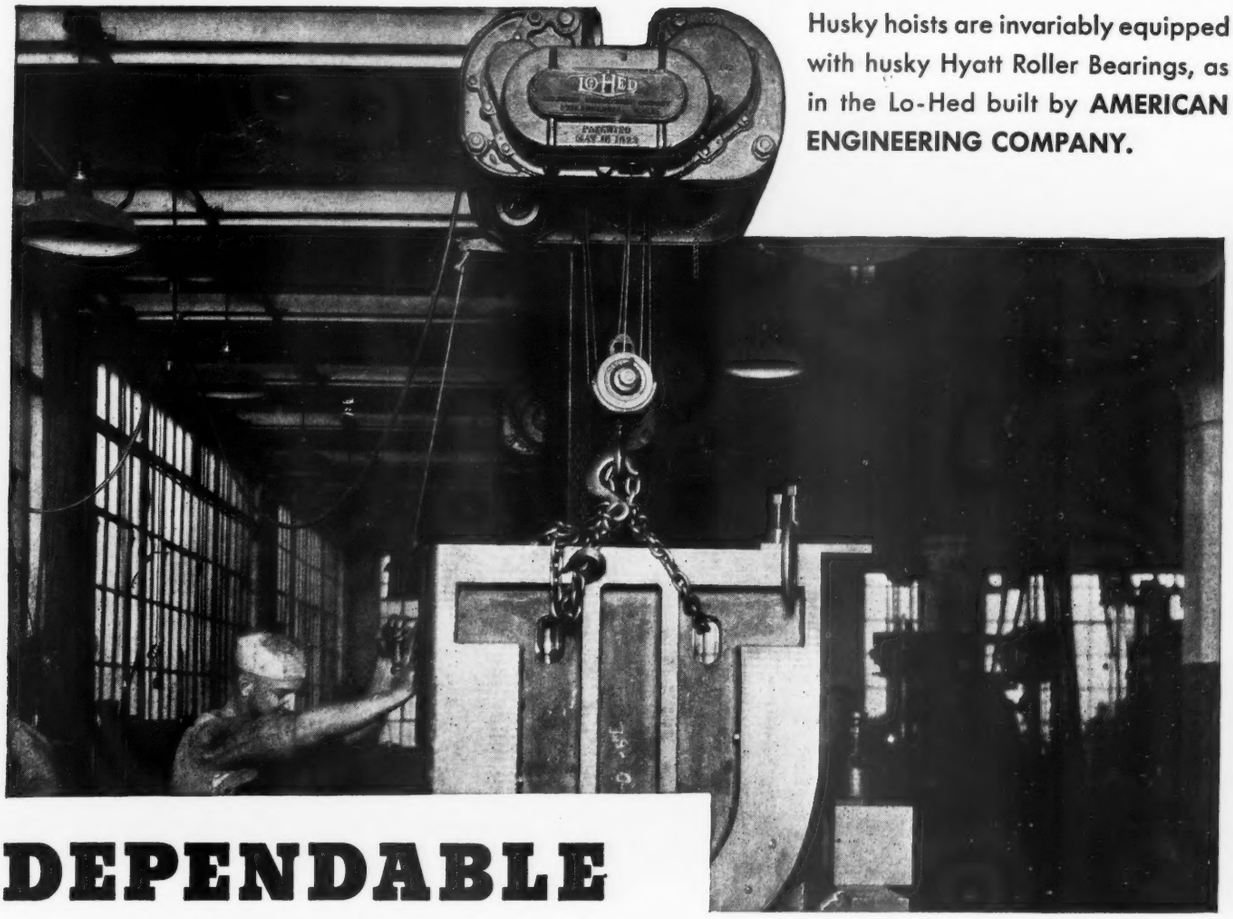
Send for these Books

Herringbone Gear Reducer Book No. 1519.

Motorized Helical Gear Reducer Book No. 1515.



Worm Gear Reducer Book No. 1524.



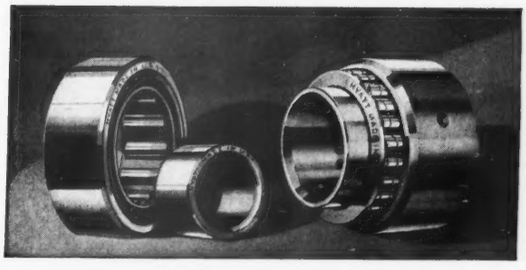
Husky hoists are invariably equipped with husky Hyatt Roller Bearings, as in the Lo-Hed built by **AMERICAN ENGINEERING COMPANY.**

DEPENDABLE

TEAM MATES FOR ALL YOUR EQUIPMENT!

Built for endurance . . . for tough going . . . for heavy loads . . . Hyatt Roller Bearings withstand cruel punishment which would make ordinary bearings old before their time. Day in and day out they do it, asking no time off for repairs and maintenance. Occasional lubrication is the only care they require.

Because they run so smoothly for so many years, in so many assignments, Hyatt Roller Bearings are always teamed with better-designed, longer-lived, and more dependable operating equipment. Line up with Hyatts! Hyatt Bearings Division, General Motors Corporation, Newark, Detroit, San Francisco. Hyatt Roller Bearing Sales Company, Chicago and Pittsburgh.

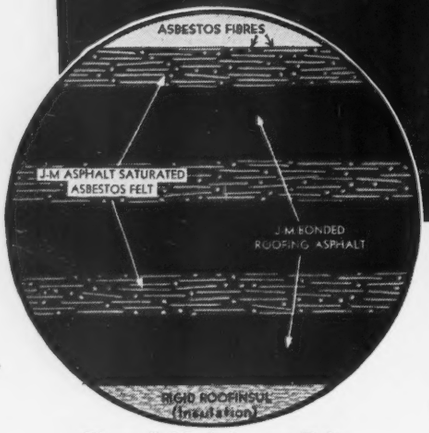


HYATT

ROLLER BEARINGS

A Conviction in 1915

AND CONFIRMATION IN 1937!



How J-M Asbestos Felts Protect the Waterproofing Asphalts from the Sun . . .

As this enlarged cross-section of a 3-ply J-M Asbestos Roof shows, each asbestos fiber is solid, non-capillary. The asphalt cannot penetrate into these fibers, *or be drawn up through them by the sun.* Hence, the asphalt—both within the felts and between the plies—retains indefinitely the lighter oils so essential to effective waterproofing.

IN 1915, a large papermaking-machinery company in upper New York State applied a built-up roof on the concrete deck over their foundry.

They were interested in securing lasting, low-cost protection for their investment in equipment and materials. And their belief in the superiority of J-M Asbestos Roofs has been more than confirmed today!

This particular J-M Roof, like scores of others throughout the country, is still in excellent condition as it nears the quarter-century mark. Explanation?

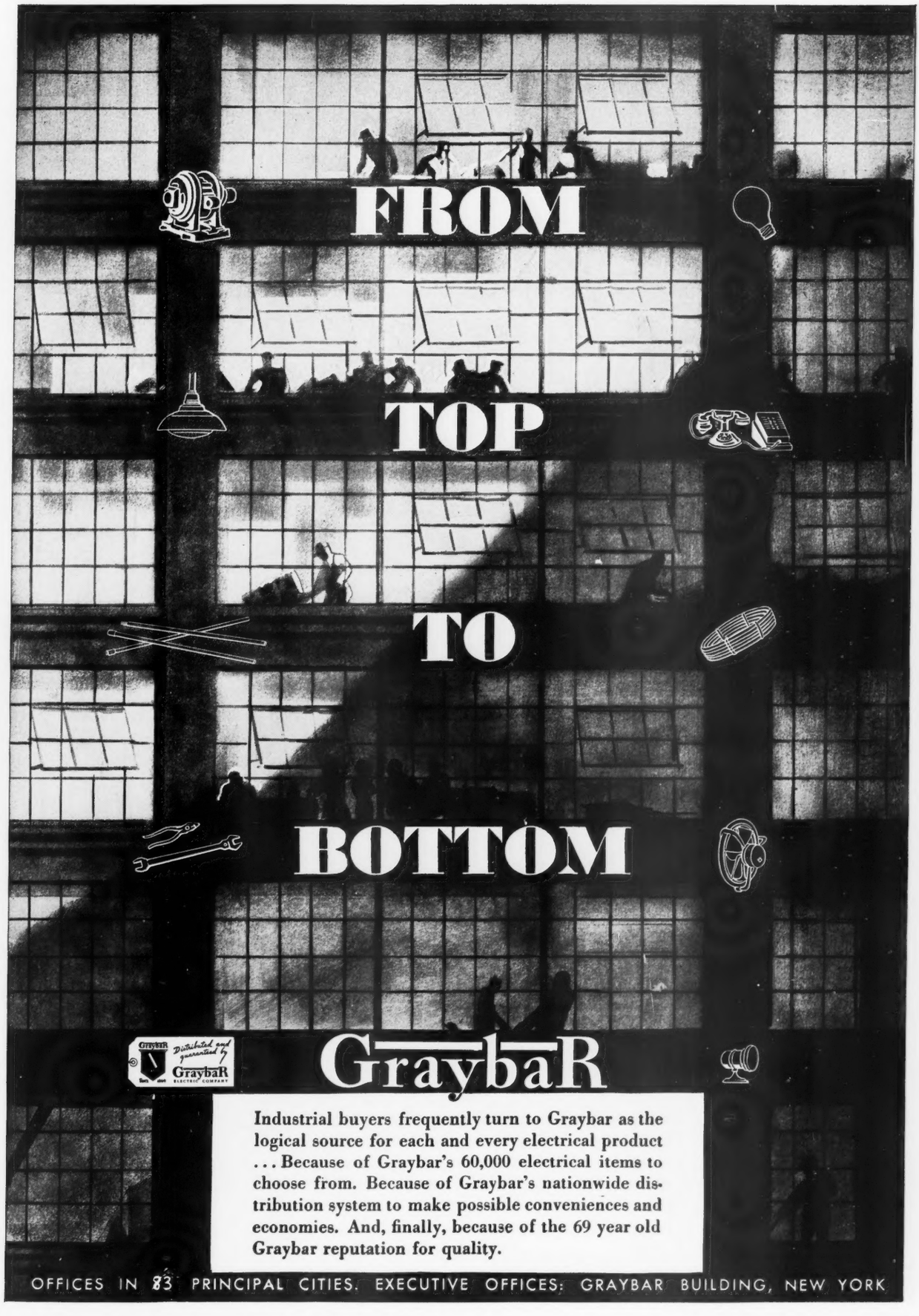
These roofs were built up with felts made of asbestos—the mineral that is fireproof, weatherproof, permanent.

But weather and fire are only two of the enemies of roofing life. A third—and equally serious one—is the sun. How its intense drying-out action is prevented by J-M Asbestos Felts is explained in the diagram and story on the left. Read the facts in that paragraph if you want the reason why J-M Roofs have established such an outstanding service record.

Valuable Book on Built-Up Roofs

"Specifications on J-M Bonded Built-Up Roofs" is a handbook giving data on roofing problems and complete information on all J-M Roofs. For your free copy, write to Johns-Manville, 22 E. 40th St., New York, N. Y.

Johns-Manville BONDED BUILT-UP ASBESTOS ROOFS


FROM
TOP
TO
BOTTOM
GraybaR
Distributed and guaranteed by
GraybaR ELECTRIC COMPANY
Industrial buyers frequently turn to Graybar as the logical source for each and every electrical product ... Because of Graybar's 60,000 electrical items to choose from. Because of Graybar's nationwide distribution system to make possible conveniences and economies. And, finally, because of the 69 year old Graybar reputation for quality.
OFFICES IN 83 PRINCIPAL CITIES. EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK

SUCCESSFUL FOR A DECADE

Simple Methods Provide COMPLETE COSTS DAILY and PROGRESSIVE PRODUCTION CONTROLS

The cost and production control methods adopted ten years ago by Mullins Manufacturing Corporation of Salem, Ohio, are serving satisfactorily today. The production of cabinets and wringers has been added to the stamping of automotive parts, washing machine tubs, etc., but the original controls have been readily adapted to changing requirements. The following results presented in an article in the February 1931 issue of Factory still are achieved daily:

"Our Cost Department wants to know every night exactly what it cost to put each job through the plant that day. Our control system was planned to get that result with the fewest possible motions. It is extremely simple and has taken a number of time-keepers off our pay roll.

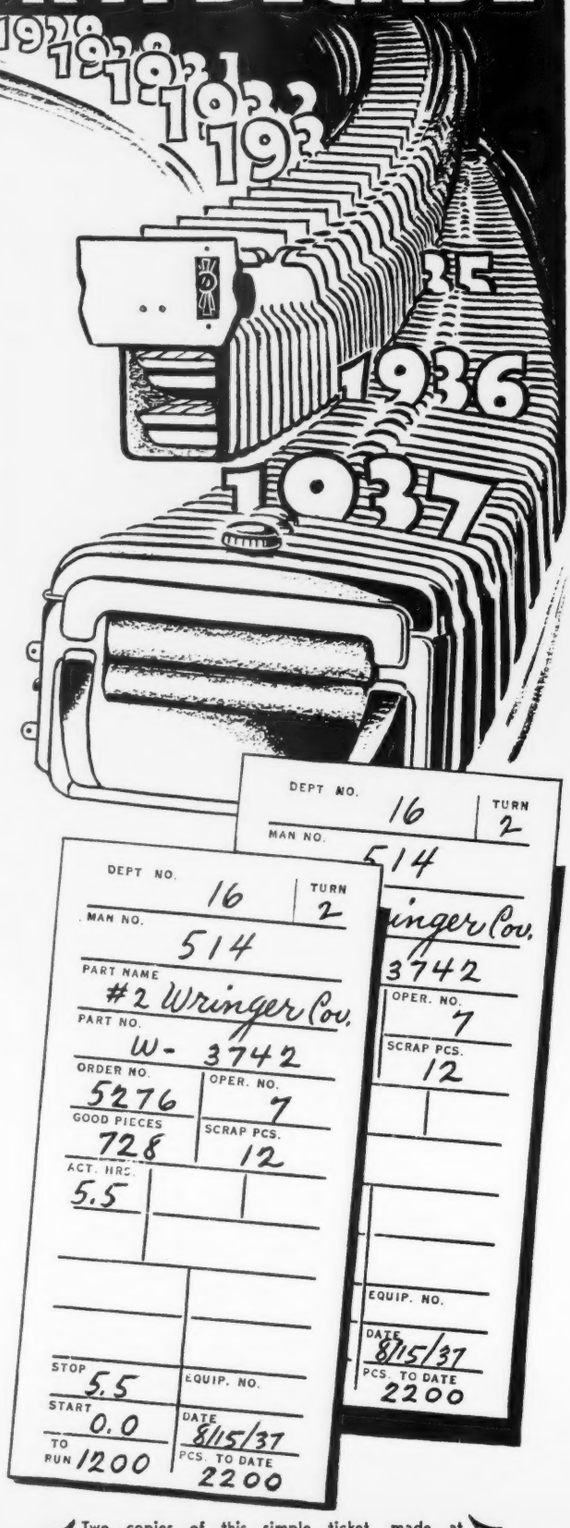
"That saving alone for the first year of operation paid for setting up the control and installing supplementary equipment. We have been so completely satisfied with the results that it has been unnecessary to change any part of it.

"Production, planning, and departmental controls provide up-to-the-minute records of the status of every job in process. Actual and standard labor costs are available a few minutes after the completion of each operation. Within an hour after quitting time, the cost department knows just what the day's operations cost.

"The system works on a sort of straight line production plan, moving along smoothly and with the utmost efficiency. Before its adoption there was a lag of at least 24 hours between the completion of operations and the availability of this data."

Your requirements undoubtedly differ from those served by these controls but every McCaskey installation is tailor-made to meet specific conditions. Write for "Pay Roll and Cost Distributions Without Posting", "Simplified Production Control" or pamphlets describing other McCaskey Industrial Controls.

THE McCASKEY REGISTER COMPANY
ALLIANCE, OHIO



Two copies of this simple ticket, made at "one-writing", visibly filed on McCaskey planning boards, provide immediate data for Mullins controls with "the fewest possible motions."

McCASKEY INDUSTRIAL CONTROLS
PRODUCTION • INVENTORY • MAINTENANCE • TOOLS • COSTS • PAYROLL

(Reading time: 25 Seconds or less)

● An automotive parts manufacturer standardized on Osborn Brushes for production work. Reason: To maintain high standards of performance with purchasing economy. But brushes used for all maintenance work were bought indifferently. Result: Lack of uniform brush quality . . . too frequent replacements . . . too much time wasted buying brushes. All that stopped when the company was told Osborn Brushes were quickly available for all brush needs in industry . . . making standardization possible . . . with resultant economy. Osborn and the Osborn Distributor in your locality can do the same for YOU. *Ask about it!*

THE OSBORN MANUFACTURING COMPANY
5401 HAMILTON AVENUE • CLEVELAND, OHIO
SALES OFFICES: NEW YORK • DETROIT • CHICAGO • SAN FRANCISCO

Specify Osborn Brushes

• THE MOST EXTENSIVE LINE OF INDUSTRIAL BRUSHES • SERVING ALL INDUSTRIES

INADEQUATE WIRING CAUSES LOSSES, TOO

Many a ship has foundered on hidden shoals . . . Production in 9 out of 10 plants is in no less danger from the "shallows" of inadequate wiring.

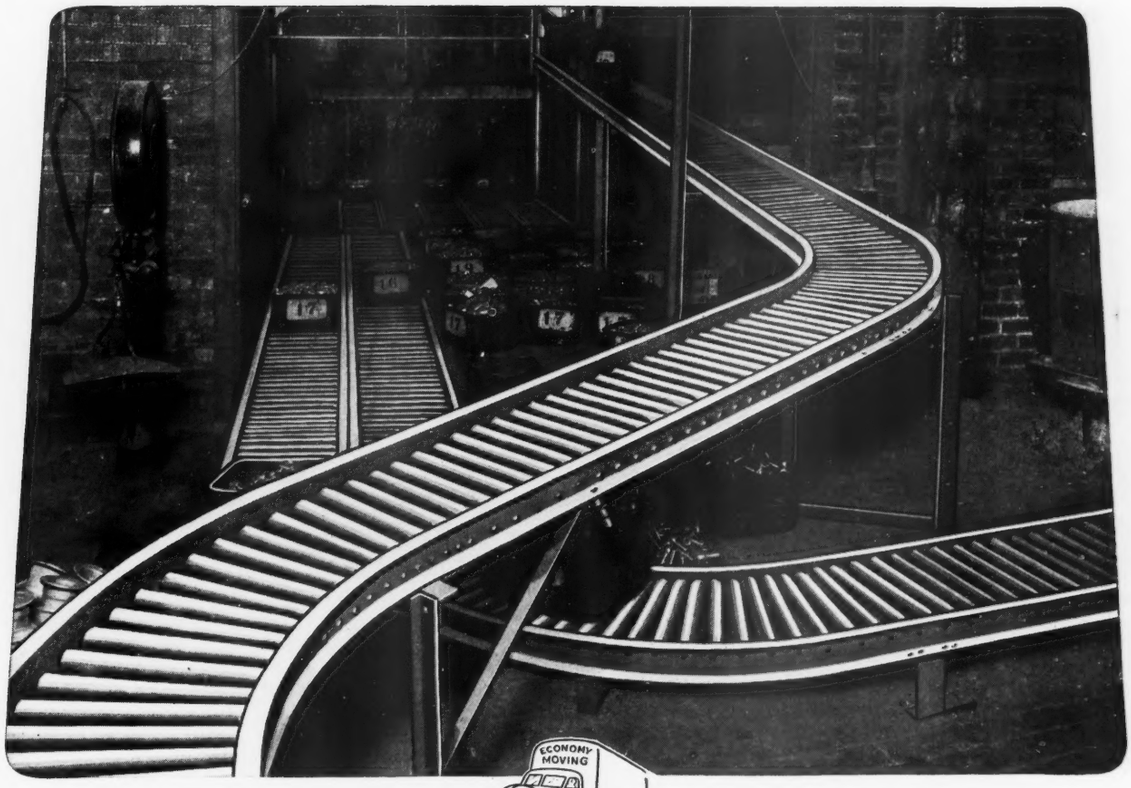
Guard against wasted power — production lags — costly breakdowns. Reduce maintenance and repair costs to a minimum. Have your wiring checked now. Make sure that men and machinery in your plant have electrical facilities to keep production rolling.

When installing new wiring, use G-E Wiring Materials. G-E White Rigid Conduit, Boxes and Fittings, G-E Wire and Cable, and G-E Wiring Devices make a complete line and are designed to be used together for permanence and economy. For information, see your nearest G-E Merchandise Distributor, or write to Section CDW-9611, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

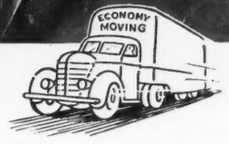
GENERAL ELECTRIC

WIRING MATERIALS

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

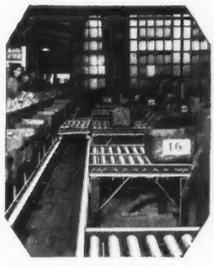


"Let's move at less cost," said this manufacturer of plumbing hardware. Lower lines of gravity conveyor move tote pans of castings from grinding machines to elevator in rear. Roller conveyor sections on elevator floor connect with other conveyors on upper floor leading to machine operations. Upper line of conveyor in photo returns empty tote pans from the machine shop to sorting bins.



Every day is MOVING DAY!

★ Every day in your plant, raw materials *move* in, shipments *move* out, work in process *moves* from stage to stage in manufacture and assembly. . . . Some authorities say moving is 90% of making! Regardless of *your* exact percentage, is it not simply good judgement to cut this major cost at every possible operation? . . . There is a Logan Conveyor engineer in your locality whose expert advice on material *movement*, can in all likelihood be used to your advantage and profit. He will be glad to call without obligation. . . . . And have you received a copy of the bulletin "7 Economies of Logan Conveyors"? A request on your letterhead will be promptly filled.



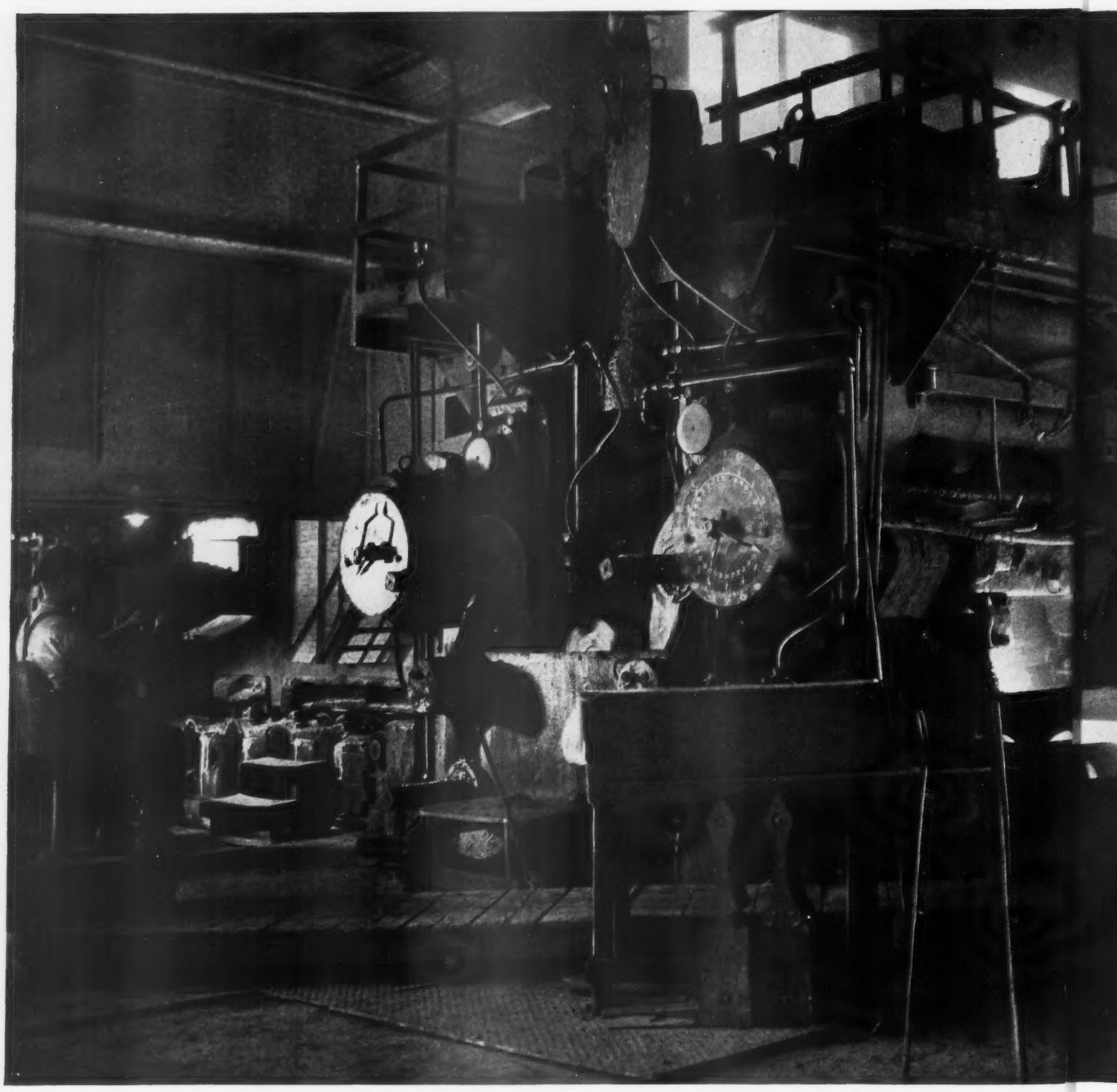
Roller Conveyor transfer car delivering parts to any one of a row of grinders.

LOGAN CO., Incorporated, Louisville, Ky.
510 Buchanan St.

MOVING IS 90% OF MAKING

Logan Conveyors
LOUISVILLE

STEEL PLANT



TEXACO

stops ROLL NECKS *OVERHEATING!*

THE superintendent of a prominent alloy steel mill was in serious lubricating trouble.

Just as things looked blackest, and he despaired of ever getting out of the rough, Texaco Engineering Service came in.

"Help us?" queried the harassed superintendent. "If you can show us a way out of this, you'll have a home here."

Result. Almost immediately their maintenance expense came down to normal, a fraction of what it had been. That is how Texaco Engineering Service operates . . . or should we say "co-operates."

Working harmoniously with your own personnel, our men sometimes work wonders, frequently merely by switching from one lube to another here, suggesting a more modern means of application there.

Trained lubrication engineers are available everywhere for consultation on the selection and application of Texaco Industrial Lubricants. Prompt deliveries assured through 2070 warehouse plants throughout the United States.

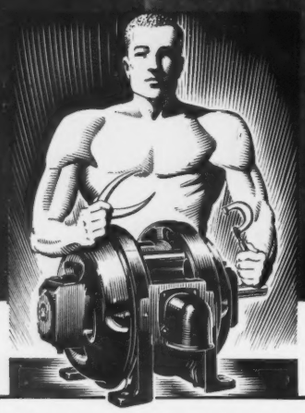
The Texas Company, 135 East 42nd Street, New York City.

One of the reasons for the success of Texaco Engineering Service is the extremely wide range of Texaco Products it recommends . . . there are more than 350 items in the line, each capable of doing a real job where properly applied.

TEXACO REG. T. M.

INDUSTRIAL LUBRICANTS

POURING PERFORMANCE



G-E MOTORS PASS ALL TESTS

Typical of methods employed throughout G-E motor factories are those followed by this husky workman in the rotor-casting section. He uses materials that measure up to rigid G-E specifications. He employs methods that have been developed as a result of hundreds of tests on completed rotors. And, finally, continuous inspections make sure that every rotor is made exactly right. At every important step in the manufacture of G-E motors, similarly exacting tests are made, not only to make sure that General Electric quality is maintained but also to find new ways to raise it *still higher.*

GENERAL ELECTRIC

020-330

INTO YOUR MOTORS

POURING molten aluminum for G-E squirrel-cage rotor windings is a process of importance to you as a motor user. On the methods employed depends a large part of the margin of G-E motor superiority in efficiency, in high full-load speed, and in uniform operating characteristics—so important to continuous, profitable motor performance in your plant.

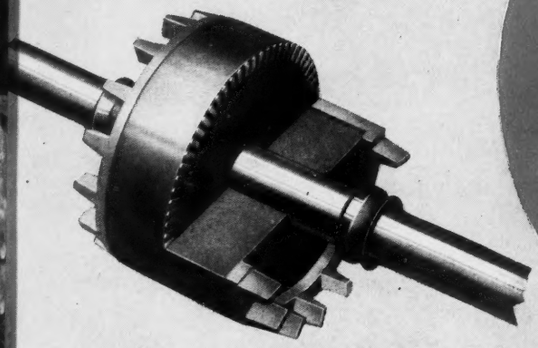
Every care is used in making these castings The aluminum is laboratory-tested for chemical purity and high conductivity. Rotation of the rotor mold under the cylindrical cover has been adjusted to give proper centrifugal force for casting. The aluminum is maintained —by automatic control—at the constant temperature most suitable for casting. Even the actual operations of the workman in pouring the ladleful of molten metal into the mold have been continually perfected by tests of hundreds of completed rotors.

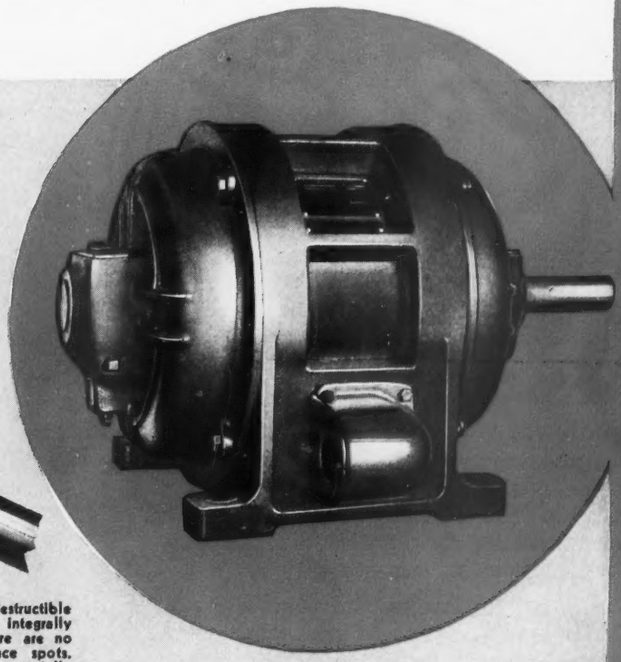
Because of this perfection of methods and materials, a practically indestructible rotor is obtained. Its homogeneous structure gives it inherent good balance, making possible smoother operation. Its freedom from joints, blowholes, and other imperfections results in better operating characteristics.

In this, as in all manufacturing processes, General Electric seeks the methods that give the best results in making individual parts. Thus, rotors for smaller motors are pressure-cast with dies because that method is best adapted to making good castings in those sizes. Whatever size of G-E motor you buy, you are assured that its rotor windings are cast by the method that means the best motor performance for you.

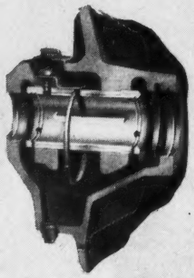
Exacting tests employed in perfecting manufacturing processes, tests made during manufacture, and tests on the completed motors are your assurance of greater value for your motor dollar in G-E motors. It will pay you to buy motors that Pass All Tests.

YOU GET THESE EXTRA-VALUE FEATURES IN G-E SKELETON-FRAME INDUCTION MOTORS (15 TO 75 HP)

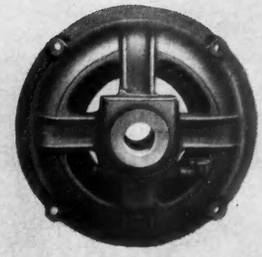




Squirrel-cage rotor with indestructible cast-aluminum windings, has integrally cast fans at both ends. There are no joints to cause high-resistance spots. Silicon-steel for punchings is specially tested to assure low core loss

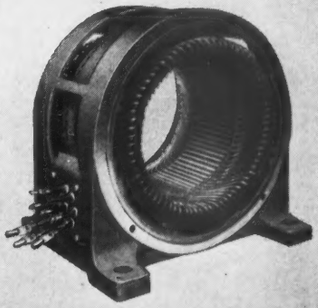


Steel-shell, babbitt-lined sleeve bearings, sealed against dust and dirt, assure long life of bearings and low maintenance costs



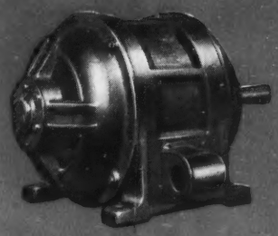
Strong cast-iron end shields protect the end windings, permit the entrance of ample cooling air, and assure rigid support for the bearings

You save time and trouble in making connections in these roomy conduit boxes. Can be mounted in any one of four positions. Leads have pressed-on, no-solder terminals



This cast-iron skeleton frame is unusually strong and rigid. High-quality insulation of these form-wound coils, used in the larger sizes, means long motor life and low upkeep costs

A G-E MOTOR FOR ANY CLASS OF SERVICE



This G-E ball-bearing motor has cartridge-type bearings and can be disassembled without exposing the bearings. Pressure-relief greasing permits lubrication without shutdown

On jobs where there are splashing or dripping liquids or falling particles, use G-E splashproof motors. They will give you longer motor life and lower operating costs

G-E totally enclosed, fan-cooled motors will quickly pay for themselves in lower upkeep on dusty, dirty jobs or in extremely moist, acid, or corrosive atmospheres

Where you need a compact, efficient, low-speed power unit, use a G-E gear-motor—it will help you reduce your power-equipment investment and operating costs

Simple as A

and MORSE ROLLER CHAINS hold 70% MORE OIL

Simplicity is the keynote of this great roller chain. The inner oil supply—70% more than ordinary chains—is a triumph of design in Morse Roller Chains. This cushion of lubrication in every roller insures quieter, gentler chain action. More power, less noise, less wear!

Hailed at its introduction several years ago as the most important advance in roller chain design, Morse Roller Chain has demonstrated its worth in hundreds of uses in thousands of industrial jobs since its first enthusiastic reception. And it's no surprise to power engineers. For top performance has been built into Morse Roller Chains from designing board to actual installation.

Special steels are used for rollers, pins and bushings. A new Spring Lock was designed to take the place of the ordinary cotter pins which were often loosened by vibration. Movement with the load was controlled to end wear on the inside of the roller.

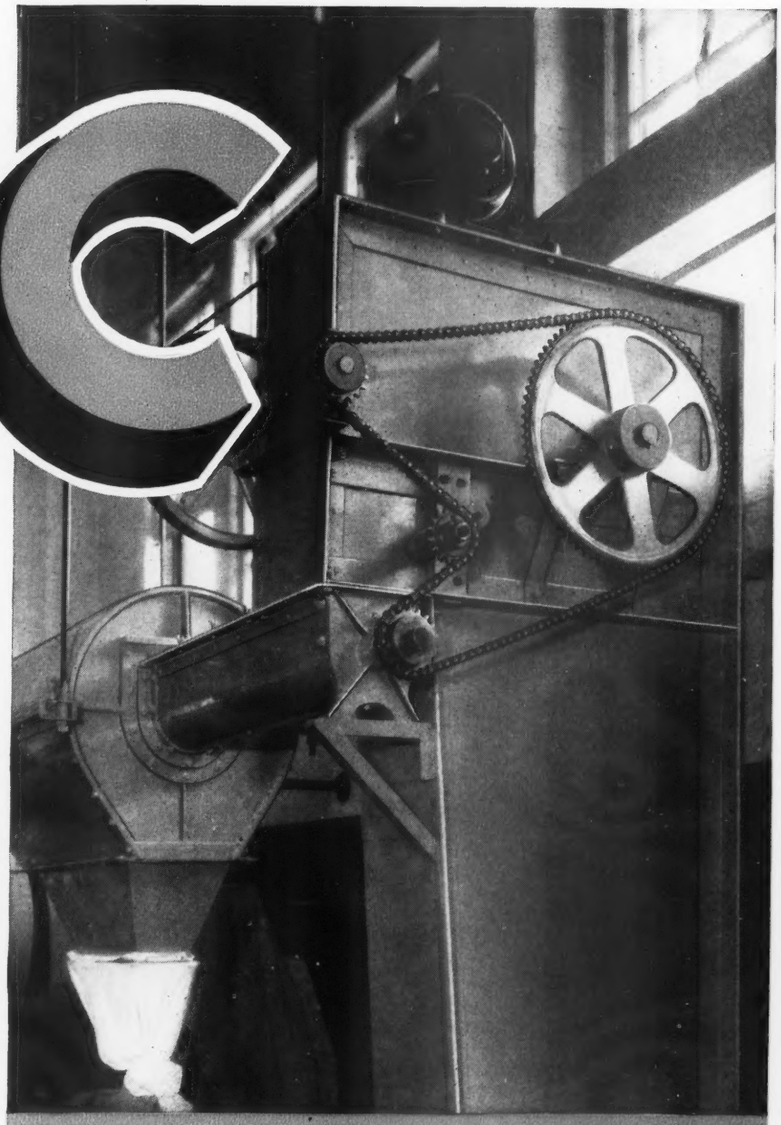
Long and short links, damaged side plates, uneven wear on the rollers—all the enemies of roller chain performance—are conquered by the long-wearing, trouble-free Morse Roller Chain.

BRANCH OFFICES IN ALL PRINCIPAL CITIES

MORSE

MORSE CHAIN COMPANY

A B C

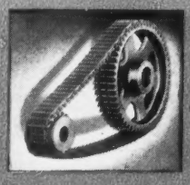


Morse Roller Chains have limitless applications in industry. From the smallest single-widths to the ponderous multiple-width chains that drive huge machines with tremendously heavy loads, Morse Roller Chains fit into the production picture.

But in addition to the usual industrial uses, Morse Roller Chains have set performance marks as truck drives, as conveyors, and in many unusual utilizations.

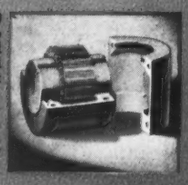
With the mounting costs of doing business, many manufacturers have been seeking ways of cutting down the cost of production. Here's one sound way: Modernize your power transmissions and get full efficiency out of them with Morse Positive Chain Drives. They actually cost no more than less efficient, less lasting types of drives. And maintenance costs take a nose dive when Morse Chain Drives take over!

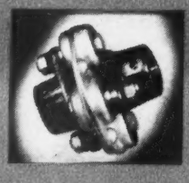
The Morse man in your territory, or Morse, Ithaca, will be glad to advise with you on your power transmission problems.



MORSE SILENT CHAIN Lower first cost, lower operation and maintenance costs. Transmits power with 98.6% efficiency.

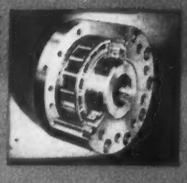
MORSE STANDARD COUPLING — Two hardened steel sprockets wrapped in a length of silent chain. A rugged, flexible unit. Furnished with a grease-tight case. Coupling literally "runs in oil."





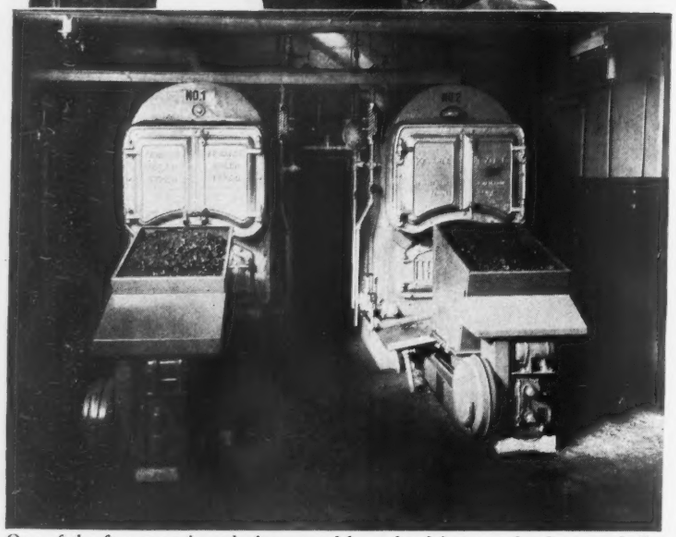
MORSE "MORFLEX" COUPLING — The Rubber flexing medium allows maximum distortion without power loss. Requires no lubrication.

MORSE CLUTCHES — Two types, Morse "Kelpo" (illustrated) for alternate or intermittent power; Morse "Indexing and Free Wheeling." Both multiple-cam construction, velvet smooth.



Roller CHAINS

ITHACA N.Y. DIVISION OF BORG WARNER CORP.



One of the first steps in reducing wasteful overhead is to modernize your boiler room with Iron Fireman automatic coal firing.

IRON

Automatic Coal production

YOU may be saddled with high fuel costs and not realize it. If you're still hand-firing the boilers in your factory there's no doubt about it—you *are* burdened with needless overhead, and you need Iron Fireman automatic coal firing equipment to lighten the load you are carrying.

Iron Fireman will put you on the *automatic side* in your boiler room. Fuel and labor costs will come down. Smoke waste will end. Fluctuations in heat will stop. Employees will do more and better work because of Iron Fireman's ability to maintain proper room temperatures. You'll have the finest automatic heating that money can buy—and make substantial savings at the same time.

Savings Help Offset Rising Operating Costs

The savings that an Iron Fireman can make take on added significance in the current era of rising prices. As every factory manager knows too well, the costs of operation are mounting rapidly. However, this added cost of operation can be minimized—in some cases perhaps offset entirely—by applying the savings that can be made with Iron Fireman firing. The

IRON FIREMAN MANUFACTURING CO.
3023 W. 106th Street, Cleveland, Ohio.

☐ Please send catalog. ☐ Make free firing survey.

*Name*_____

*Address*_____

IRON FIREMAN

AUTOMATIC *Self Regulating* COAL FIRING

FIREMAN

Heating cuts operating costs—increases efficiency

chances are that an Iron Firemanized boiler room will result in savings of 15c to 35c on every dollar now spent for fuel. Such is the performance record in factory buildings from coast to coast, and your property should not prove an exception.

Free Firing Survey

There is only one definite way to find out what Iron Fireman can do for you. This is to secure a firing survey from your dealer which will give you all the facts—not only as to what you may expect in better heat, but also what an Iron Fireman should save over your present firing method. There is no cost or obligation for this survey service. Ask for it—or write to the factory for literature. Iron Fireman Manufacturing Co. Factories: Portland, Oregon; Cleveland, Ohio; Toronto, Canada. Dealers everywhere.

Saves $300 a Month

Universal Sanitary Mfg. Co., *New Castle, Pa.* "Two Iron Fireman stokers under our 250 h.p. water tube boilers are operated continuously. They maintain uniform steam pressure and save $300 a month."

Reduces Steam Costs $2160 a Year

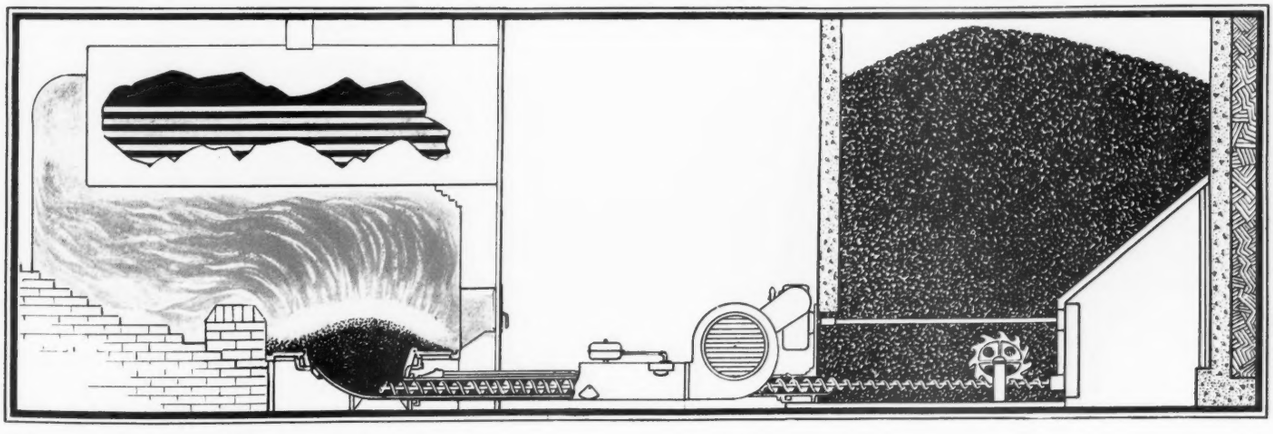
Haeger Potteries, Inc., *Dundee, Ill.* "Great reduction in steam costs with Iron Fireman. Coal consumption increased only 20 per cent when we doubled our production. Our actual savings have been $180 a month."

Pays Dividends 4 Ways

Allen-A Co. of Canada, Ltd., *Hanover, Ont.* Iron Fireman has cut fuel costs; firing room labor; provided steady power; increased boiler efficiency. "We are glad to recommend Iron Fireman to anyone considering the installation of a machine of this type."

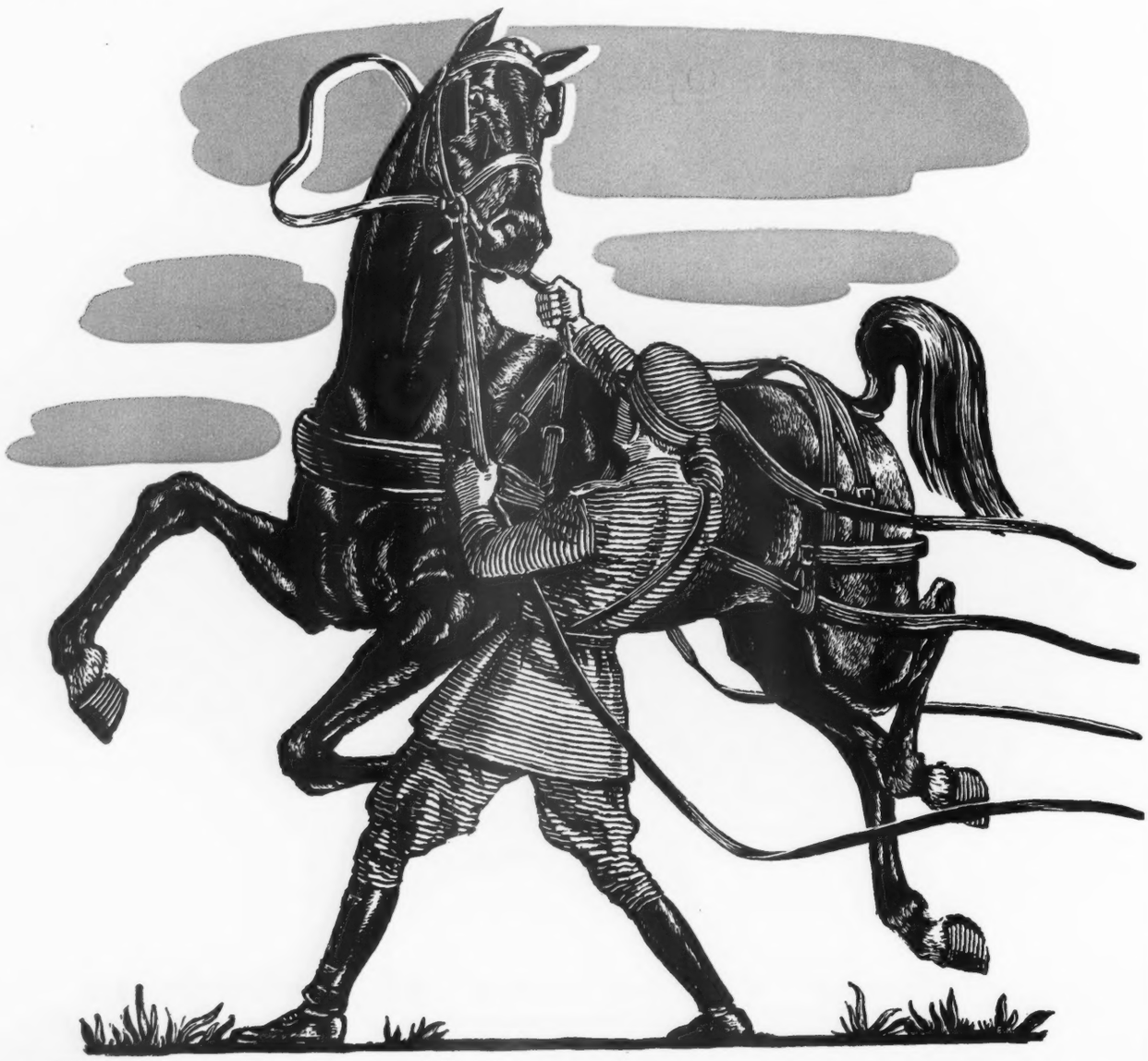
Iron Fireman Cuts Fuel Cost 25%

Blue Bell Overall Co., *Greensboro, N. C.* "In one season Iron Fireman cut fuel costs $450 or 25 per cent. We have steady even heat throughout the plant, increased efficiency and better working conditions for our employees."



No Coal Handling: **Iron Fireman stokers can be installed to feed direct from the coal bin or bunkers, thus eliminating coal handling entirely as the coal can be delivered direct to the bunker from the truck or cars. Such installations are models of cleanliness and convenience. They are inconspicuous, and require a minimum of attention.**

"WE'VE STOPPED



INDUSTRIAL TYCOL OILS-GREASES

TIDE WATER

THERE IS A COMPLETE LINE OF TYCOL LUBRICANTS

The Flying Yankee, Crack Train of the Boston and Maine and Maine Central Railroad, is one of many Diesel powered units lubricated with Tide Water Diesel Lubricants.

Soap is a thickening agent which controls the rate of flow of the lubricant to the bearings, just as a sponge controls the water it has absorbed.

Maximum economical lubrication per pound of grease is assured by the use of cylinder oil, making a minimum of soap necessary.

THE RUNAWAY!"

THIS MANUFACTURER suffered from runaway lubrication. It would not "stay put." In his words, "Since we've been using Tide Water Green Cast Greases we've reduced the number of applications by 50%. There's also less grease used on the bearings of the mills where grease is pumped under pressure. Tide Water Grease resists the heat better. It maintains body to insure a good film to protect the bearing."

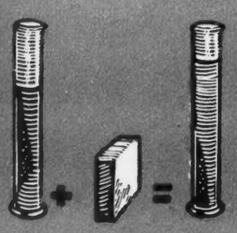
Operators in every branch of industry find that Tide Water's Green Cast Greases make light work of the tough jobs. They are compounded of the highest grade of paraffine base cylinder oil and a minimum of soap. More lubricating oil and less soap means more lubrication per pound of grease.

Look for the natural green cast . . . it identifies Tide Water's Green Cast Greases. Try them on your hardest jobs first and get the most convincing proof — the irrefutable evidence of better performance and economies of operation. We will gladly recommend the proper consistency for any application.

TIDE WATER ASSOCIATED OIL COMPANY
TIDE WATER DIVISION
17 Battery Place, New York, N. Y.

GREEN CAST GREASES

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE



Tycol Green Cast Greases are made of paraffine stock cylinder oil — having high flash and fire points, with maximum film strength.

Tycol Green Cast Greases are compounded to suit every operating condition — for indoor and outdoor service, for anti-friction or plain bearings.

. . . FOR FIFTY YEARS

AMERICAN MUTUAL HAS REDUCED ACCIDENTS, LOWERED INSURANCE COSTS AND INCREASED PRODUCTION EFFICIENCY . . .

The specialized engineering service that comes to all American Mutual policyholders along with the workmen's compensation coverage they *have* to provide — protects both men and profits, and aids smooth-flowing production.

Results are as striking in Maine as in Minnesota, in Florida as in Louisiana, in food plants as in foundries, in wood-working firms as in textile mills, BECAUSE

the Safety Engineering Plan for each concern is individually shaped for the utmost effectiveness

Study of *its* conditions and past experience leads to the diagnosing and safeguarding of *its* particular sources of danger.

Safety is economically planned for the plant as a whole — men, methods and machines — as well as the obvious mechanical hazards.

Plant supervisors guided by this engineering service inspire alertness for safety among *all* employees, from top executive to lowest-waged worker.

The amount of service is gauged by the needs of each plant — not by a standard routine.

Results? See the typical cases on the opposite page. Very likely one or two are firms in your own industry and in your own location. Note the records in increasing safety and lowering insurance costs made by plants like yours.

3 PROFIT OPPORTUNITIES FOR YOU

. . . from safety work by our engineers, helping you to lower insurance costs, prevent uninsured losses such as interruptions to production, damaged equipment, lowered morale, and loss of experienced personnel.
. . . from medical care of the injured, with doctors skilled in restoring ability to work, saving for their employers their valuable years of experience.
. . . from a cash dividend that for 50 years has uninterruptedly saved our policyholders 1/5 or more of their insurance costs each year.
. . . Write for free subscription to our magazine, which gives practical aids for safety and management men.

American Mutual Liability Insurance Company,
Dept. 53, 142 Berkeley Street, Boston, Mass.

Please send me the next four issues of the AMERICAN MUTUAL MAGAZINE.

*Name*_____

*Company*_____

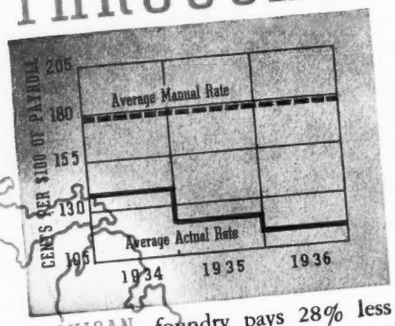
*Address*_____

American Mutual

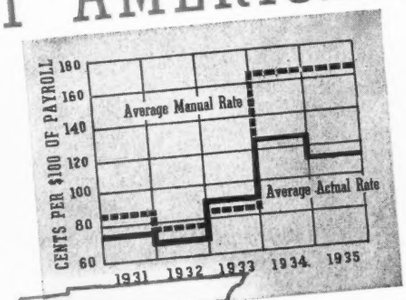
Admitted Assets: $29,786, 487.87 *Liabilities: $24,777,652.84*
Surplus to Policyholders: $5,008,835.03 *As of Dec. 31, 1936*

BRANCHES IN 54 OF THE

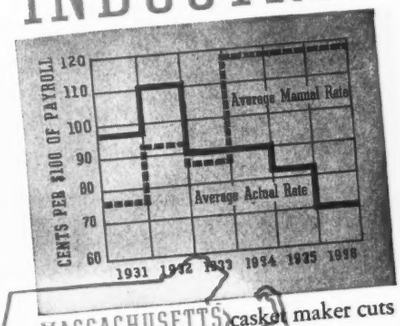
THROUGHOUT AMERICAN INDUSTRY



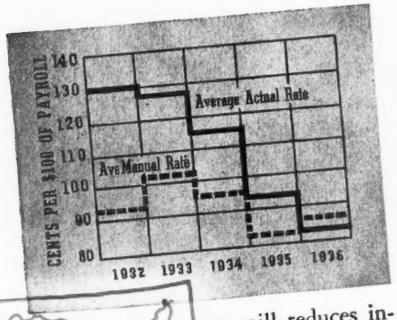
MICHIGAN foundry pays 28% less than average — its own rates reduced by 18% in two years



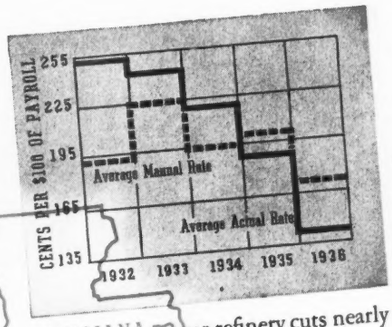
TENNESSEE chemical plant pays only $\frac{2}{3}$ average rate — though it paid more than average in 1933



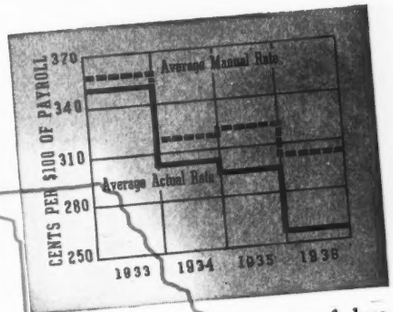
MASSACHUSETTS casket maker cuts insurance costs 39.4% while average rises 28.3% — now pays only 60% of average



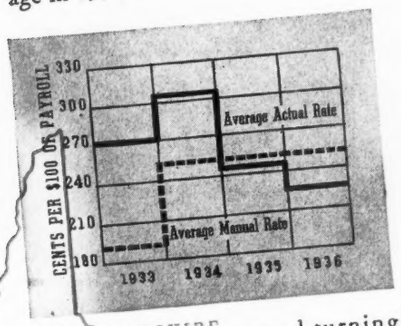
MARYLAND cotton mill reduces insurance costs by $\frac{1}{3}$ — paid 40% more than average in 1932, less than average in 1936



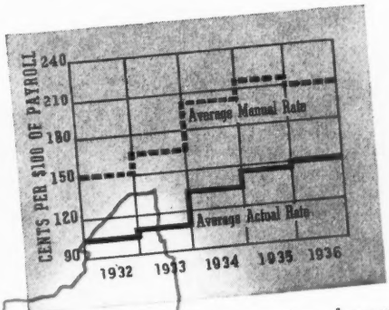
LOUISIANA sugar refinery cuts nearly $\frac{1}{2}$ off insurance bill — from $\frac{1}{3}$ above average to 1/5 below



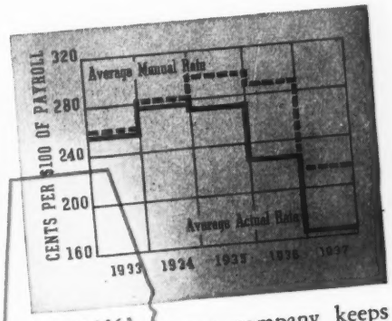
MISSOURI metal plant pays $\frac{1}{4}$ less than in 1934 — and considerably less than average



NEW HAMPSHIRE wood-turning firm lowers insurance costs by 26.5% in two years



NEW YORK beverage maker keeps costs 29% — 35% below average every year for the past 5 years



ALABAMA cement company keeps reducing insurance costs well in advance of the average for its industry

IN CHARTS ABOVE broken line shows average manual rates per $100 payroll for workmen's compensation insurance in that state and in that industry . . . solid line shows rate paid by our policyholder, lowered by good safety experience.

works to make all work safe

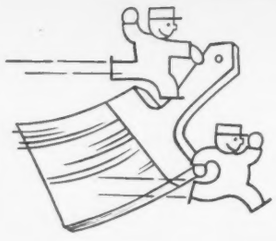
Savings on automobile insurance, public liability and other lines have always been 20% or more each year — even greater savings on general fire insurance, written by our associate, Allied American Mutual Fire Insurance Company.

COUNTRY'S PRINCIPAL CITIES

1887

FIFTIETH ANNIVERSARY 1887-1937

THE HIGHEST QUALITY PAINT...



IT'S NEVER ECONOMY to use a cheap paint in a plant like yours. For cheap paint just hasn't got what it takes to do a high-standard, low-cost job. Ordinary white paint works slowly . . . hinders the painter . . . covers less surface . . . doesn't hide well . . . "yellows" quickly. It means more paint per job and more frequent repaintings.

Barreled Sunlight is the paint for you . . . the standard by which all whites are measured. Check its 5 vital qualities . . . you won't find all 5 in any other white paint. That's why Barreled Sunlight is a standard specification in industrial plants everywhere. It goes on faster, stretches further per gallon, remains white longer, and gives your walls a clean, smooth, good-looking surface that's as durable as rawhide. And it actually *costs less per finished* job. U. S. Gutta Percha Paint Company, 2-K Dudley Street, Providence, R. I.

THE LOWEST FINISHED COST!

Barreled Sunlight
INTERIOR ENAMEL
WHITE
Only Barreled Sunlight possesses these 5 Vital Qualities...
WHITER... being the whitest of whites, it is greater in light-reflecting power.
WHITE LONGER... danger of "yellowing" greatly reduced.
HIDES BETTER... often one coat covers where two coats of ordinary paints may be necessary.
SPREADS FARTHER... less paint for job... less time and labor to apply it.
FLOWS EASIER... a quicker job... less expense for time and labor.
Barreled Sunlight

"We spiked shutdowns on our Grinders by using . .

FUSES MADE TO PROTECT -NOT TO BLOW"

BUSS Super

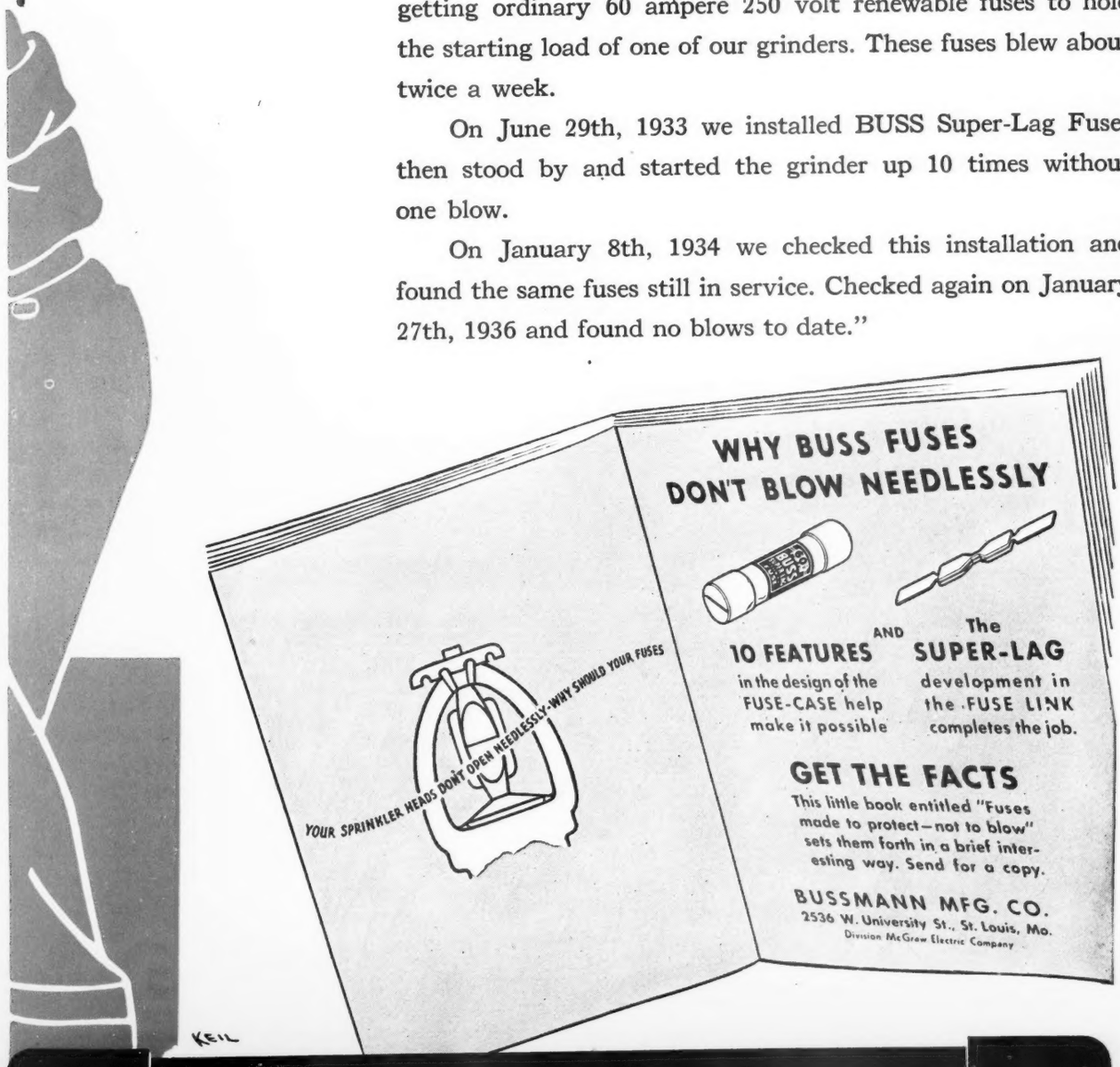
HERE'S THE STORY... Says

Mr. R. MONROE, Chief Electrician of American Brake Shoe and Foundry Co., Mahwah, N. J.

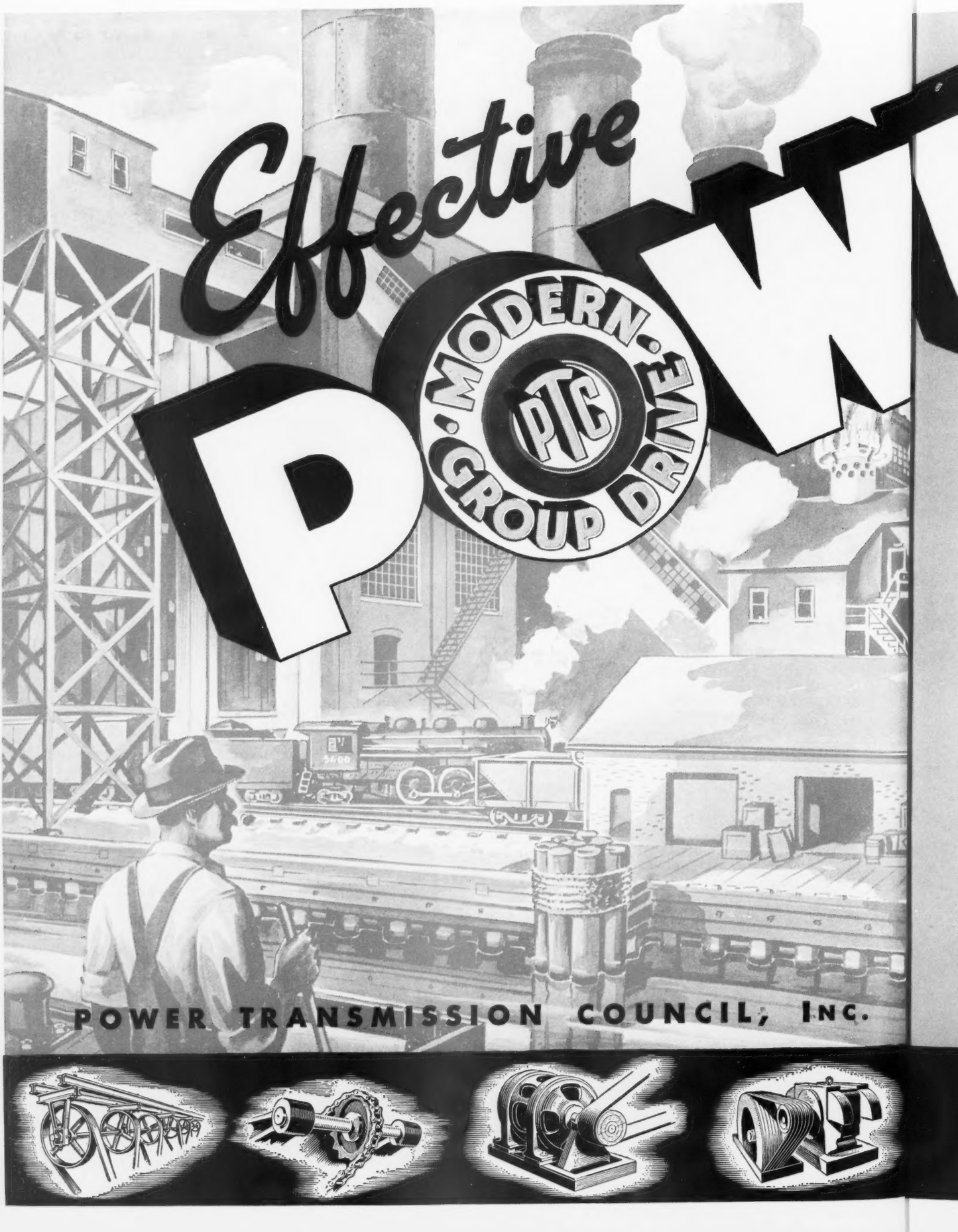
"Prior to June 29th, 1933 we experienced great trouble in getting ordinary 60 ampere 250 volt renewable fuses to hold the starting load of one of our grinders. These fuses blew about twice a week.

On June 29th, 1933 we installed BUSS Super-Lag Fuses then stood by and started the grinder up 10 times without one blow.

On January 8th, 1934 we checked this installation and found the same fuses still in service. Checked again on January 27th, 1936 and found no blows to date."


YOUR SPRINKLER HEADS DON'T OPEN NEEDLESSLY-WHY SHOULD YOUR FUSES
WHY BUSS FUSES DON'T BLOW NEEDLESSLY
10 FEATURES AND The SUPER-LAG
in the design of the FUSE-CASE help make it possible
development in the FUSE LINK completes the job.
GET THE FACTS
This little book entitled "Fuses made to protect—not to blow" sets them forth in a brief interesting way. Send for a copy.
BUSSMANN MFG. CO.
2536 W. University St., St. Louis, Mo.
Division McGraw Electric Company
KEIL

Lag FUSES


Effective
POWER
MODERN
PTC
GROUP DRIVE
POWER TRANSMISSION COUNCIL, INC.

ER Utilization

ASSURES A BETTER PLANT — PRODUCT — PROFIT

"PLANNED POWER TRANSMISSION" insures increased and more effective power utilization. It means greater production efficiency, flexibility to accommodate future changes, lower maintenance costs, lower power costs and — increased profits.

"Planned Power Transmission" means the selection of power drives best suited for individual operating conditions and the proper combination of individual and group drives which will get the power from source to driven machine most effectively and with minimum loss.

Engineers of the Power Transmission Council—collaborating with plant, consulting and power engineers and members of the Nation's Power Transmission Clubs—are constantly conducting power transmission surveys in many different industries. In some cases they have found power wastes running as high as 38%. Without fees or obligation of any kind their findings have simplified production flows, insured fewer service interruptions and cleaned up shop appearance.

Power Transmission Council engineers have no special cause to plead — no one type of drive to recommend. They are interested solely in selecting the *combination* of drives best suited to each particular case. This is the consultive service manufacturers may have by addressing the Power Transmission Council. Why not check your own production flow — in the interests of a *better plant — product and profit!*

1. NATIONAL ORGANIZATION: The Power Transmission Council is the official spokesman for the Power Transmission industry. It is incorporated under the laws of the State of Delaware. It is committed to a broad program in behalf of more effective power utilization in industry.

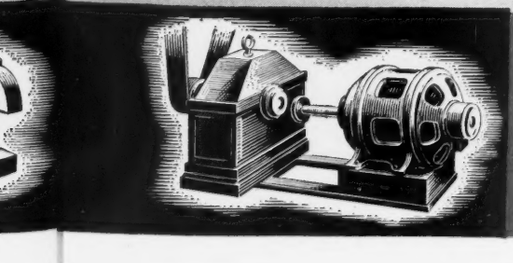
2. SOUND ENGINEERING: Only one laboratory is recognized by Power Transmission Council—the industrial plant. From studies made by competent and experienced engineers facts have been accumulated which guide recommendations and are available to industrial executives in the form of Case Studies.

3. REGIONAL ENGINEERS: A staff of competent power transmission engineers is maintained in leading industrial centers. They deal with facts—their recommendations are unprejudiced — their goal is more effective power utilization through planned power transmission.

4. LOCAL ENGINEERING ORGANIZATIONS: 3,500 members of Power Transmission Clubs in industrial centers, affiliated with the national organization and working in cooperation with Regional Engineers are daily assisting industrial executives in the solution of their power transmission problems.

5. EFFECTIVE MERCHANDISING: The facts accumulated as a result of the Council Research program are used as a basis for a broad educational program and are widely distributed in the form of many valuable publications covering the many phases of industrial power transmission practice. Write headquarters for a complete list.

75 STATE STREET, BOSTON, MASSACHUSETTS



PLANNED *Power* TRANSMISSION

SAVE POWER

. . . in starting

. . . while running

American Steel Split Pulleys require less power to operate—*in starting*, because they are lighter —*while running*, because their flat, edge-on arms cut the air, reducing resistance—*continuously*, because the high frictional capacity of "American" steel faces guarantees minimum belt slip. Moreover, this "split" type pulley is more easily installed and interchangeable bushings make these pulleys readily adaptable for re-location on other shafts. There are "Americans" designed for all types of service, and maximum power transmission at minimum cost is of assured interest to everyone.

Do This...

Write today for copy of our latest catalog listing full details of construction, sizes, engineering data, and prices. The descriptive literature makes a valuable ready reference. It can prove a source of substantial maintenance economies. Send for it at once.

MODERN GROUP DRIVE PTC

Modern Group Drives provide the opportunity industry has long sought to really capitalize on the superior features of American Steel Split Pulleys.

The Power Wise Group Their Drives

AMERICAN
PULLEY COMPANY
4200 WISSAHICKON AVE. PHILADELPHIA, PA.

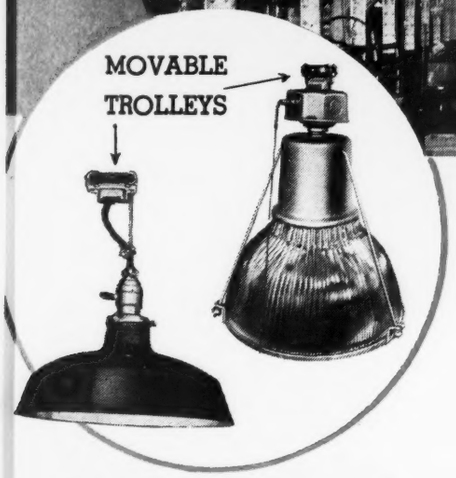
"LIGHTS ON WHEELS"

Approved AS THE ULTRA MODERN METHOD OF OVERHEAD LIGHTING

OK

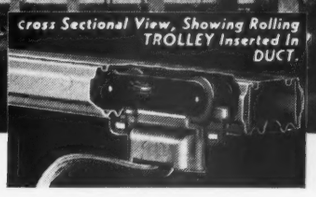
BULL DOG
UNIVERSAL TYPE
Trol-E-Duct

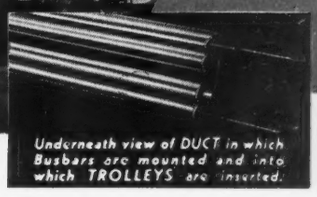
This photograph shows a complete factory installation of Bull Dog Universal Type Trol-E-Duct —a modern system of movable electric outlets for flexible lighting fixture arrangements.



Two types of lighting fixtures each attached to a TROLLEY which serves both as feeder and movable means. Any type of standard lighting fixtures can be adapted to Trol-E-Duct.

The movable, current carrying TROLLEY


Cross Sectional View, Showing Rolling TROLLEY Inserted In DUCT.


Underneath view of DUCT in which Busbars are mounted and into which TROLLEYS are inserted.

Bull Dog Universal Trol-E-Duct makes it possible for you to avoid the LIMITATIONS and EXPENSE of a FIXED Lighting System. Bull Dog Universal Trol-E-Duct system of "Lights on Wheels" is FLEXIBLE. Lighting units can be moved in either direction along the Duct run, enabling you to change the position or increase the number of your Lighting units to meet the changing working level requirements. Every inch of the entire Duct run is a potential source of current.

Write for Illustrated Bulletin

BULL DOG ELECTRIC PRODUCTS COMPANY

Pioneers of Flexible Electrical Distribution Systems

DETROIT, MICHIGAN

BULL DOG ELECTRIC PRODUCTS OF CANADA, LTD., TORONTO, ONT.

Odd Job Man

Most versatile of the Baker line, Baker Crane Trucks are daily saving time and money in the many odd jobs of handling steel. Change of lifting equipment only, from hook, as illustrated, to magnet, tongs, chain sling, rack or any special device permits the same crane to handle a wide variety of materials. You'll find its usefulness practically unlimited, its daily savings an important factor in cutting plant operation costs. • Get all the facts on handling costs from the Baker Materials Handling Engineer.

You'll find his data on time and cost savings detailed and accurate, his suggestions practical and helpful, in solving your own handling problems. There's no obligation, just write to BAKER INDUSTRIAL TRUCK DIVISION, *of the Baker Raulang Company,* 2178 West 25th St., Cleveland, Ohio.

OLDEST MANUFACTURER
Baker
TRADE-MARK REG. U. S. PAT. OFF.
OF ELECTRIC VEHICLES

POWER INDUSTRIAL TRUCKS FOR EVERY PURPOSE

GULF DEPENDABILITY PROVED! ON UTAH SALT BEDS

87 world and international speed records were smashed by Ab Jenkins in his powerful racing car shown above—raising world's unlimited 24-hour record to average of 157.27 m.p.h. He also broke the 1-hour record at a speed of 177.05 m.p.h.

Car driven by Ab Jenkins photographed while breaking 36 "unlimited" and 36 "Class C" stock closed car records—all well above 100 m.p.h. For 24 hours he averaged 101.72 m.p.h.

Ab Jenkins sets 159 new speed records.... using Gulfpride Oil and No-Nox Ethyl Gasoline

(Supervised and timed by the Contest Board of the American Automobile Association)

NO special lubricants or fuels were used by Ab Jenkins when he recently hung up 159 new speed records with his big racer and his stock car sedan on the Bonneville salt beds in Utah.

He used the same Gulfpride Oil and Gulf No-Nox Ethyl Gasoline that are giving thousands of car owners new motoring economy and satisfaction every day! *The same gas and oil you can buy for your car from any Gulf dealer!*

Gulfpride Oil has unique qualities which make it an ideal lubricant for all operating conditions. It is refined by a special process — Gulf's exclusive and patented Alchlor process — which removes 20% more waste, carbon, gum and sludge-forming elements. The result is an oil of greater stability, greater resistance to oxidation, better lubricating qualities and longer life.

This same refining process is used in the preparation of Gulf's finest industrial lubricants. Thus, operators of steam turbines, air compressors, Diesel engines and many other types of industrial equipment can secure for their engines and machines the same protection against friction, wear and repair expense that Ab Jenkins received from Gulfpride Oil when he made 159 new speed records in Utah. GULF OIL CORPORATION · GULF REFINING COMPANY, GENERAL OFFICES, PITTSBURGH, PA.

GULF INDUSTRIAL LUBRICATION

WHEN AMERICAN GOGGLES GUARD HIS EYES...

they Guard your Costs

Sole trustee of $4,000 of your money — that is the official capacity of every pair of goggles worn in your plant. For that amount is roughly the price of two eyes that lack protection at the instant they need it.

Without goggles, you may pay less — or more. But whatever you pay . . . when you get through with compensation, medical bills, charges for administration, lost time and production . . . costs are often out of sight. And there's no telling how high they may go.

There's no cost-control without eye-protection. And eye-protection, in itself, is actually inexpensive — only averages about a dollar per eye. What's more, it's readily available, quickly put in force without disturbing plant routine. Take advantage of the *only complete* eye-protection service . . . call in the local American representative. Have him survey your plant, plan and provide the proper equipment for each man and hi job.

AMERICAN OPTICAL COMPANY

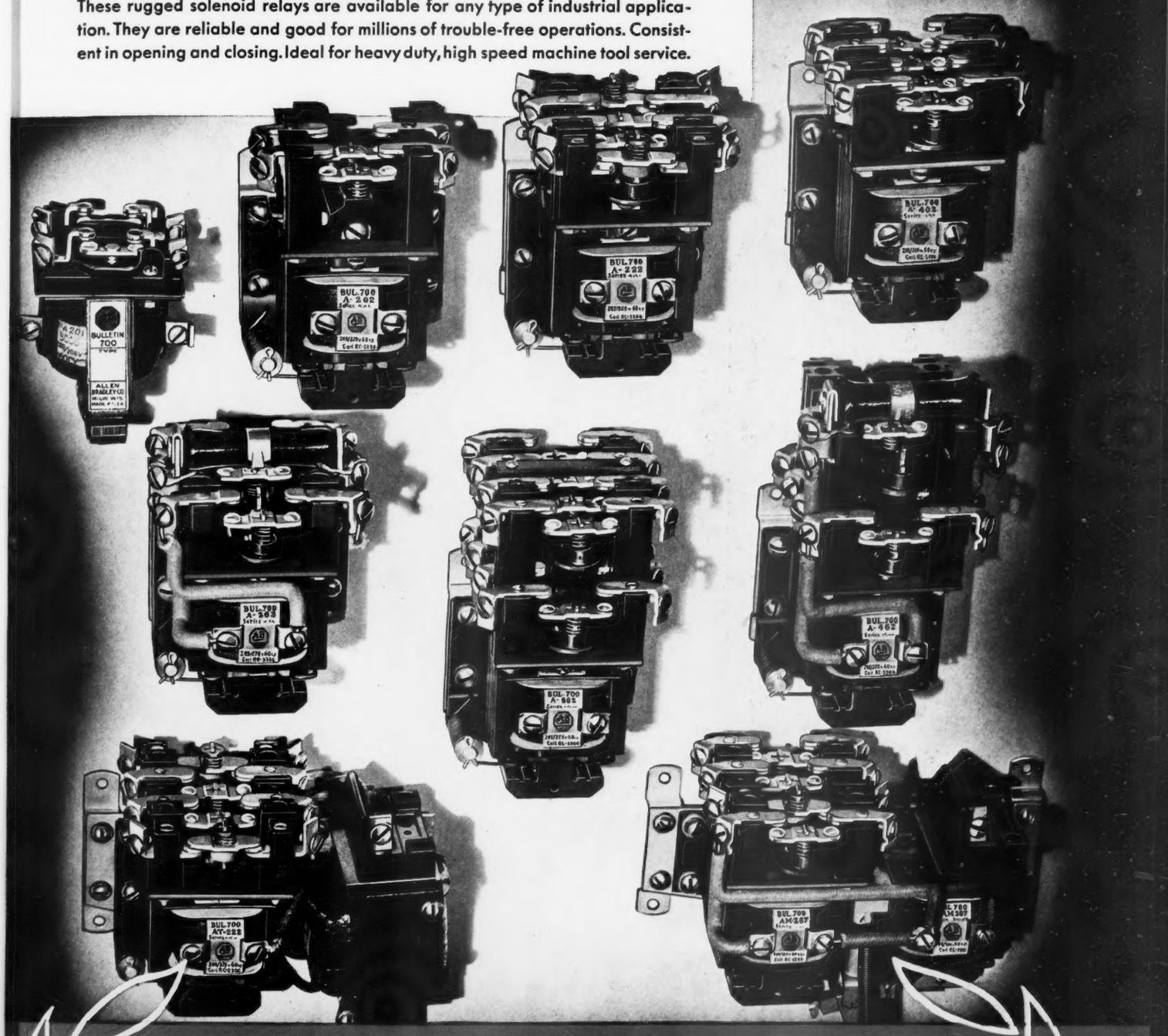
Manufacturers, for more than 100 years, of products to aid and preserve vision. Factories at Southbridge, Mass. In Canada, Consolidated Optical Co., Ltd. Branch Offices in all principal industrial centers.

4266

OVER 300 TYPES

BULLETIN 700 SOLENOID RELAYS

These rugged solenoid relays are available for any type of industrial application. They are reliable and good for millions of trouble-free operations. Consistent in opening and closing. Ideal for heavy duty, high speed machine tool service.



ALLEN-BRADLEY

QUALITY

The world's most dependable industrial relays—

BULLETIN 700 SOLENOID CONTACTORS

—newly improved for even better performance

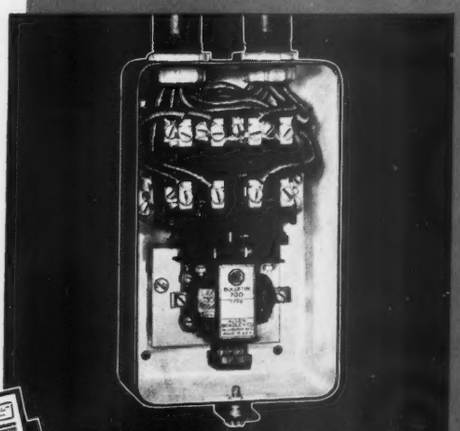
Over five years ago, Allen-Bradley developed the first modern solenoid contactor—the Bulletin 700. This relay established an unequaled reputation for ruggedness, dependability, exact operation, and long life. Thus, it soon became standard equipment on modern high-speed machine tools.

Now, new refinements—the result of five years' field experience on production jobs—have been incorporated in Bulletin 700 solenoid contactors. The relays have been rearranged to make the wiring terminals easily accessible. Now a clear view is obtained down all contacts. The contacts themselves have been made larger. More millions of operations have been added. However, the basic design of the Bulletin 700 relay remains unchanged. The up-and-down solenoid motion, the double break, silver alloy contacts, and other design features responsible for the relay's success have not been altered.

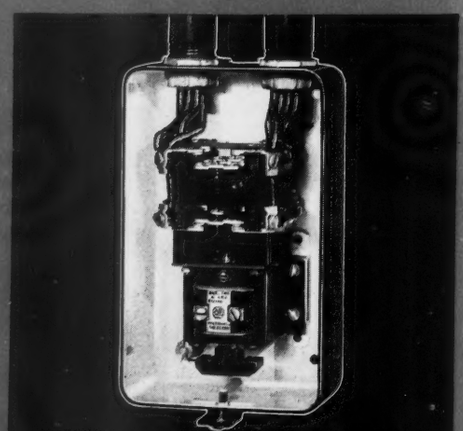
If you require exact relay operation, write Allen-Bradley. They have a Bulletin 700 relay that will solve your problem.

As the above illustration of an 8-pole Bulletin 700 solenoid relay shows, a clear view is obtained down all contacts. Notice also the easy accessibility of all terminals.

A-B



With the old mounting, wiring the back contacts was a difficult job. The wired relay presented this jumbled appearance.



With the new relay mounting, it is easy to wire all connections. The finished job presents this neat and orderly appearance.

SEND

for Bulletin 700

Allen-Bradley Company,
1310 S. Second Street,
Milwaukee, Wisconsin.
Please send me a copy of Bulletin 700.

Name.....

Company.....

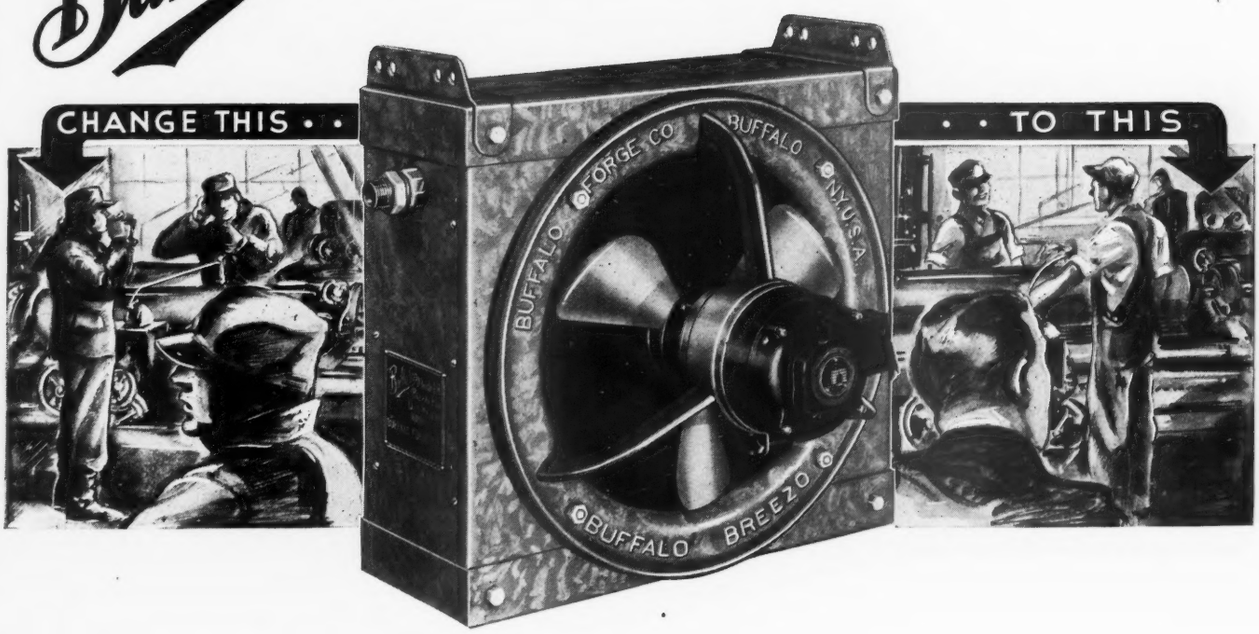
Street.....

City.....State.....

ALLEN-BRADLEY

SOLENOID MOTOR CONTROL

These Accurately Rated "Buffalo" UNIT HEATERS



• The ease and simplicity with which "Buffalo" Unit Heaters change cold, drafty, inefficient working conditions to the *right* efficient working temperatures is little short of amazing. These accurately rated, ruggedly built, quiet Unit Heaters make an instant hit with both men and management. For the men—they spell comfort and health. For the management—the same things plus far more efficient heating.

Because of their superior design and construction, "Buffalo" Unit Heaters are suitable for low or high pressure steam.

Most models are available for immediate shipment. Write for Bulletin No. 3050.

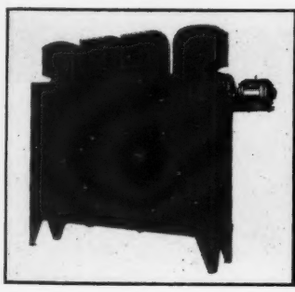
See our exhibit at the Fifth International Heating and Ventilating Exposition, Grand Central Palace, New York—January 24 to 28, 1938

BUFFALO FORGE COMPANY

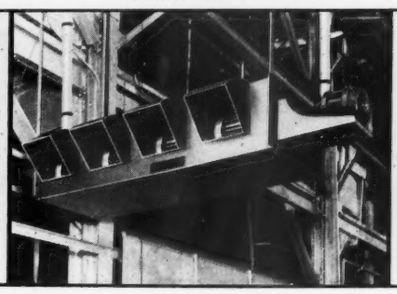
471 BROADWAY BUFFALO, N. Y.

Branch Engineering Offices in Principal Cities
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

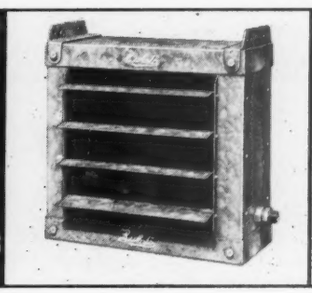
Highboy—Floor type for heating large areas. Distributes warm air in several directions.



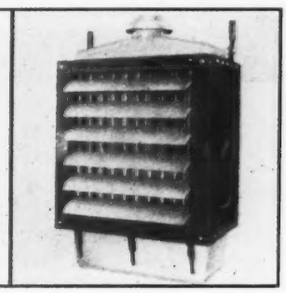
Lowboy — Flat suspended type. Same construction as Highboy, but built for ceiling mounting to conserve floor space.



Breezo-Fin—the highly efficient Unit Heater for small areas or rooms. Exceptionally quiet.



Gas Unit Heater—Where gas is readily available, many prefer this triple-safe "Buffalo" Gas Unit Heater.



YOU OUGHT TO know this

The Power Salesman from the lighting company is proud of the commodity he sells. He knows that when used correctly, electricity delivers value far beyond its cost. For this reason, he endeavors to see that electrical equipment and wiring are of proper design and size, and that everything is correctly installed.

Anaconda Wire &

General Offices: 25 Broadway, New York • Chicago Office: 20 North Wacker Drive

Man BETTER!

YOU ought to know him better... this man who represents your utility company. He may be able to save you hundreds, even thousands, of dollars.

You find time to scold the workman who leaves a faucet dripping. You grumble when a little gasoline is spilled. But when the Power Salesman calls ...*an expert who is hired just to save you money*... does he often find you "busy"?

Nine out of ten industrial plants need to modernize electric circuits

It is a fact, authorities say, that nine out of ten industrial plants today are wasting money needlessly through neglect of electric power distribution. Many electric circuits have grown "like Topsy." Electric wires and cables are of antiquated design...and hopelessly overloaded. No wonder dollars fly out the window in the form of heat losses, breakdowns, high maintenance and repair bills.

Your utility wants you to get full use of the power you buy. Utility executives know that electricity rightly used leads to the sale of more power. That is why the utility invests thousands of dollars in service. It hires as Power Salesman a man who is an *expert* in things electrical.

He can show you how to save money

The Power Salesman today is cooperating with Anaconda Wire & Cable Company in presenting to industry the need of modernizing electrical circuits. He knows, as we know, that one of the best investments you can make is in new electrical equipment. He knows, as we know, that modern, improved wires and cables, by eliminating breakdowns and reducing power bills, will save many times their cost.

Your Power Salesman has a great story to tell you. Why not get in touch with him? It will pay you!

MODERNIZED WIRING AIDS PLANT OPERATION IN THESE SIX WAYS

1. Prevents breakdowns that retard production and cause labor to lose wages.
2. Prevents light losses and slowing down of machines due to voltage drop.
3. Prevents dissipation of power in the form of invisible heat losses.
4. Lowers maintenance and repair costs.
5. Permits shifting of equipment or installation of new machinery with minimum delay.
6. Protects safety of workers and lowers insurance rates —a permanent saving!

DO THIS NOW!

Right now, your Power Salesman has a valuable suggestion to make. Initiate a "wiring survey" in your plant. These books give complete directions. Such a survey will cost you nothing—may save you many dollars. Copies of these books will be mailed on request.

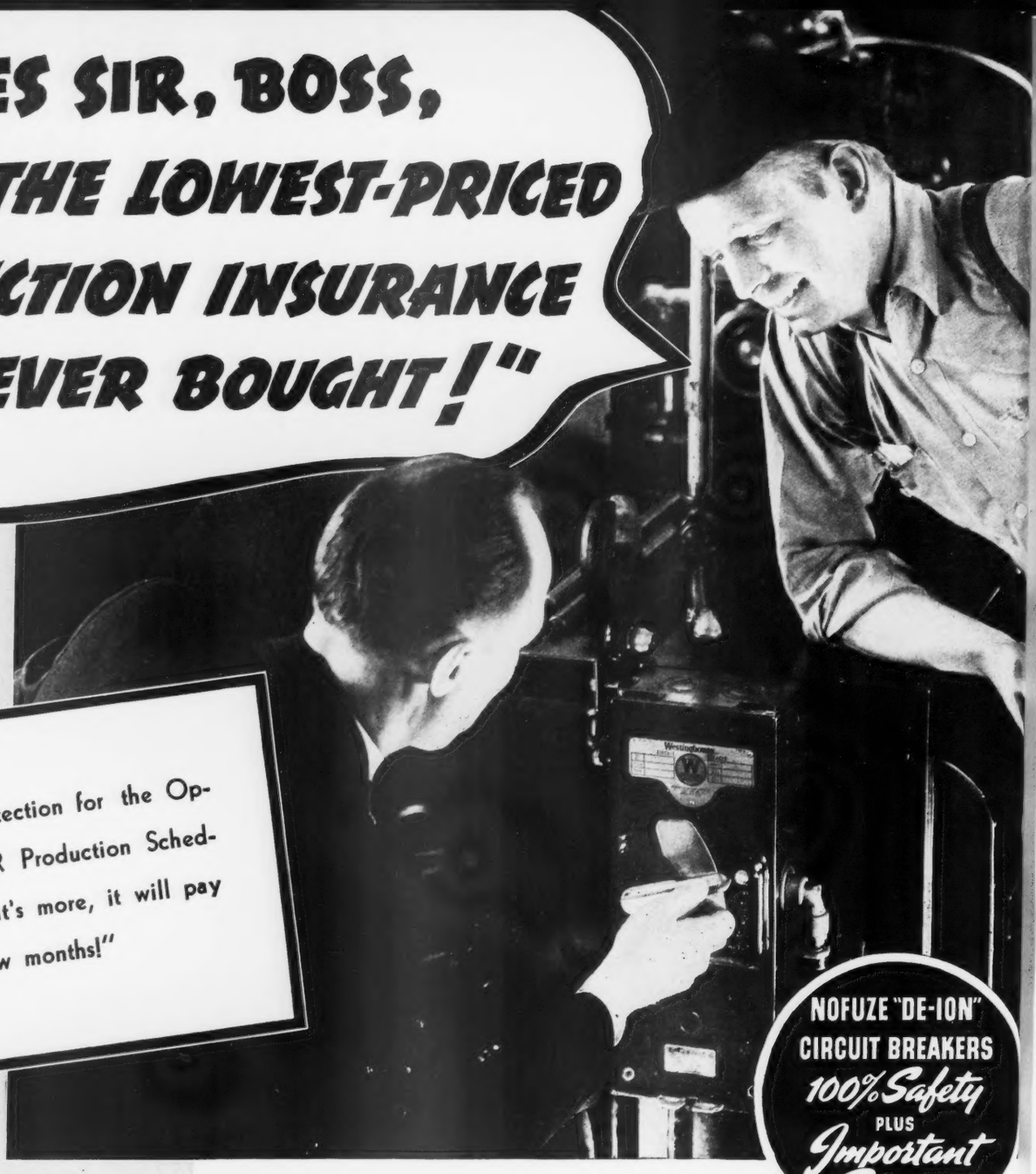
37534-A

Cable Company

Sales Offices in Principal Cities

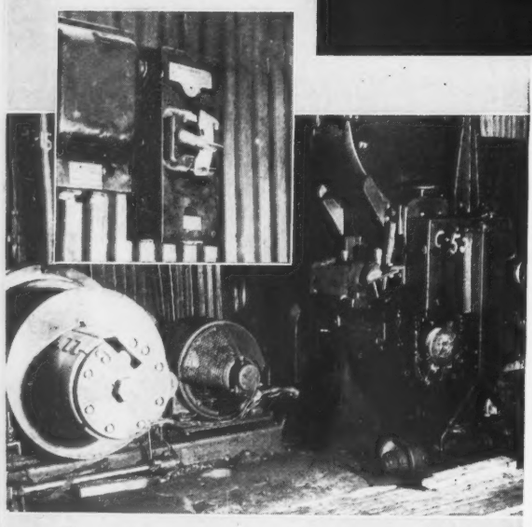
ANACONDA
from mine to consumer

"YES SIR, BOSS, THAT'S THE LOWEST-PRICED PRODUCTION INSURANCE WE EVER BOUGHT!"



"It's sure-fire protection for the Operator and YOUR Production Schedules . . . and what's more, it will pay for itself in a few months!"

NOFUZE "DE-ION" CIRCUIT BREAKERS
100% Safety
PLUS
Important Savings



COST $18 . . *Saves* $24 MONTHLY IN PRODUCTION COSTS!

●The work of four men was delayed 5 to 10 minutes on an average of four or five times each day, when this strip reel in a metal fabricating plant was protected by a fused switch. Lost man hours alone cost at least $24 per month. An $18 Nofuze Breaker replaced the fused switch . . . paid for itself in less than a month!

●The electrician is right. Nofuze Circuit Breakers provide real:

SAFETY TO WORKMEN because all live parts are totally enclosed . . . covers are *bolted* on and need never be opened to restore service.

SAFETY TO MACHINES AND CIRCUITS because the mechanism is tamper-proof and trip-free, cannot be held closed against severe overloads. And . . .

PROTECTION FOR PRODUCTION SCHEDULES because electrical service can be restored immediately when dangerous overloads are removed. The all-too-frequent drains on profits by fuse outages . . . costly losses of time by men and machines, fuse renewals, resultant delays in rush production schedules . . . ***all are banished when you install Nofuze Circuit Breakers.***

It will pay you to investigate NOW. Call your nearest:

WESTINGHOUSE OFFICE
INDUSTRIAL AGENT
ELECTRICAL WHOLESALER
MOTOR DEALER

Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. J 20334

W WESTINGHOUSE ELECTRIC **Westinghouse**

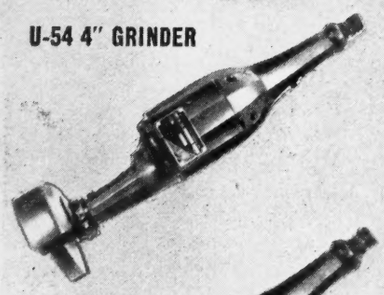
NOFUZE "DE-ION" CIRCUIT BREAKERS

LEFT: Note the smooth operation and ease of handling of this powerful Thor portable grinder as it takes off a burr on a heavy casting.

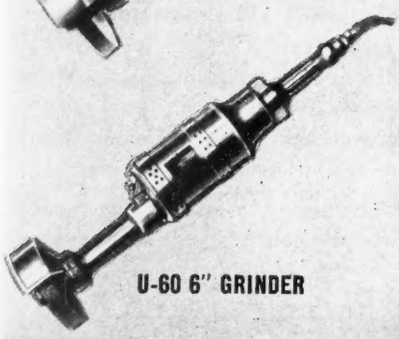
ABOVE: "Cross Section of a Cost Cutter." The resilient steel strips in the patented Thor "Shock-Absorber" Spindle positively prevent ruinous vibration from reaching the motor on Thor Portable Electric Grinders.

Thor

U-54 4" GRINDER



U-55
5" GRINDER



U-60 6" GRINDER

A THOR GRINDER FOR EVERY JOB

THOR VIBRATION-CONTROL *SLASHES* Grinding Costs

Thor portable electric grinders give you grinding power wherever the job may be! They eliminate costly handling and save hours of non-productive time. In addition, they assure you of dependable, uninterrupted service and low maintenance costs because Thor's Vibration-Control prevents ruinous vibration from causing excessive wear and motor burnouts.

Basic reason for this long life and low upkeep is the patented Thor Shock-Absorber Spindle, a two-piece shaft joined with flexible steel strips, that absorbs and STOPS all vibration at the spindle . . . before it reaches the motor! The resilient steel strips — not the motor — take the terrific shocks when these powerful grinders go to work. The result is smooth operation, easy handling, longer life . . . and lower maintenance costs!

The Shock-Absorber Spindle, found only in Thor portable electric grinders, is another example of the improvements Thor engineers are constantly perfecting in their search for ways to increase the life and value of portable electric tools. And portable electric tools, as Thor makes them, are improving operations and cutting costs in thousands of plants. To find out what they could save you, write to:

"MOTOR DESIGN"
THOR Armatures — triple-insulated, hand-wound and formed, are insurance against grounds, shorts and open circuits.
THOR Commutators — built as separate units on a brass sleeve instead of steel, eliminate high bars and floating segments.

INDEPENDENT PNEUMATIC TOOL CO.
600 WEST JACKSON BOULEVARD · CHICAGO · ILLINOIS
New York Pittsburgh Detroit St. Louis Los Angeles

TOOL MAKERS Thor SINCE 1893

PORTABLE ELECTRIC TOOLS

Cut your FETCH and CARRY Costs

A few G-W products:

- Apron Conveyors
- Barge Unloaders
- Belt Conveyors
- Buckets and Elevators
- Bunkers
- Slat Conveyors
- Chain Conveyors
- Flight Conveyors
- Chutes
- Centrifugal Elevators
- Oven Conveyors
- Screw Conveyors
- Tray Elevators
- Industrial Cars
- Tiering Machines
- Storage Tanks
- Unit Elevators
- Coal and Ice Handling Systems
- Weigh Larries

Mechanical handling of the right kind, produces marked economies with small investments. From raw materials to finished packages—from arrival, through manufacturing, packaging and storage to transportation—there is equipment designed and produced by Gifford-Wood to meet any given requirements. Whether it's a job of handling apricots or ashes, candles or coal, ice or ingots, bottles or bags, cases or cartons—into, within or out of the plant, Gifford-Wood equipment will solve the handling problem—conserve investment, avoid congestion, speed production, increase capacity, economize space requirements, promote economy.

Consult Gifford-Wood engineers—their experience covers the mechanical handling problems of all industries. A new catalog has just been printed. Write for a copy.

GIFFORD-WOOD CO.

OPERATING C. W. HUNT CO. DIVISION

HUDSON, N. Y.

565 W. Washington St., Chicago — Graybar Building, New York

7284

Truly "THE FLOOR of CAPTIVE SUNLIGHT"

In the Wrapping Room of Drake Bakeries, as throughout the entire plant, Hard Maple Floors insure exceptional cleanliness, sanitation and low cleaning cost.

Hard Maple Floor in the Doughnut Make-up Room of Drake Bakeries, Inc., Brooklyn Plant.

The Packaging Room — floored with tough-fibred, tight-grained Northern Hard Maple. Heavy truck traffic is speeded up over its hard, smooth surface.

AFTER choosing a floor material for durability, it is gratifying to discover you're also reducing lighting costs, increasing efficiency and acquiring an impressive advertising feature. Many a factory has found these "plus" values in Northern Hard Maple. Its smooth, light-colored surface virtually captures sunlight—helps provide a maximum of clear light for accurate work and minimum lighting costs.

Beyond durability, daylight saving is one of the "plusses" of a Hard Maple floor—like its warmth, dryness, resilience, simplified alterations and lower cleaning and maintenance cost.

These "plus" values are well known to the Drake Bakeries of Brooklyn, who state:

"We use Hard Maple Floors in our cake bakeries because they are durable and free from dust. Our employees find them easy on their feet.

"We have used the steel wool buffing equipment of sealing and dry cleaning our Maple Floors for several years. This process has kept them immaculate and made them still more durable as it keeps the wood hard and sealed. They look like ballroom floors, even in areas that are trucked over constantly.

"Our Maple Floors, when maintained this way, have definite advertising value for us, since no one can visit our plants without being favorably impressed by the clean, wholesome appearance of our floors."

No matter what you produce in your factory, when you floor with Hard Maple, all these reasons combine to insure your satisfaction and greatest ultimate economy. Before building or remodeling, consult your architect about **MFMA*** Northern Hard Maple, (available in strips or blocks) the only flooring whose grading is **MFMA** supervised.

See our catalog data in Sweet's, Sec. 17/66.
Write us for folder on Heavy-Duty Finishes.

MAPLE FLOORING MANUFACTURERS ASSOCIATION
1787 McCormick Building, Chicago, Illinois

Floor *with* Maple

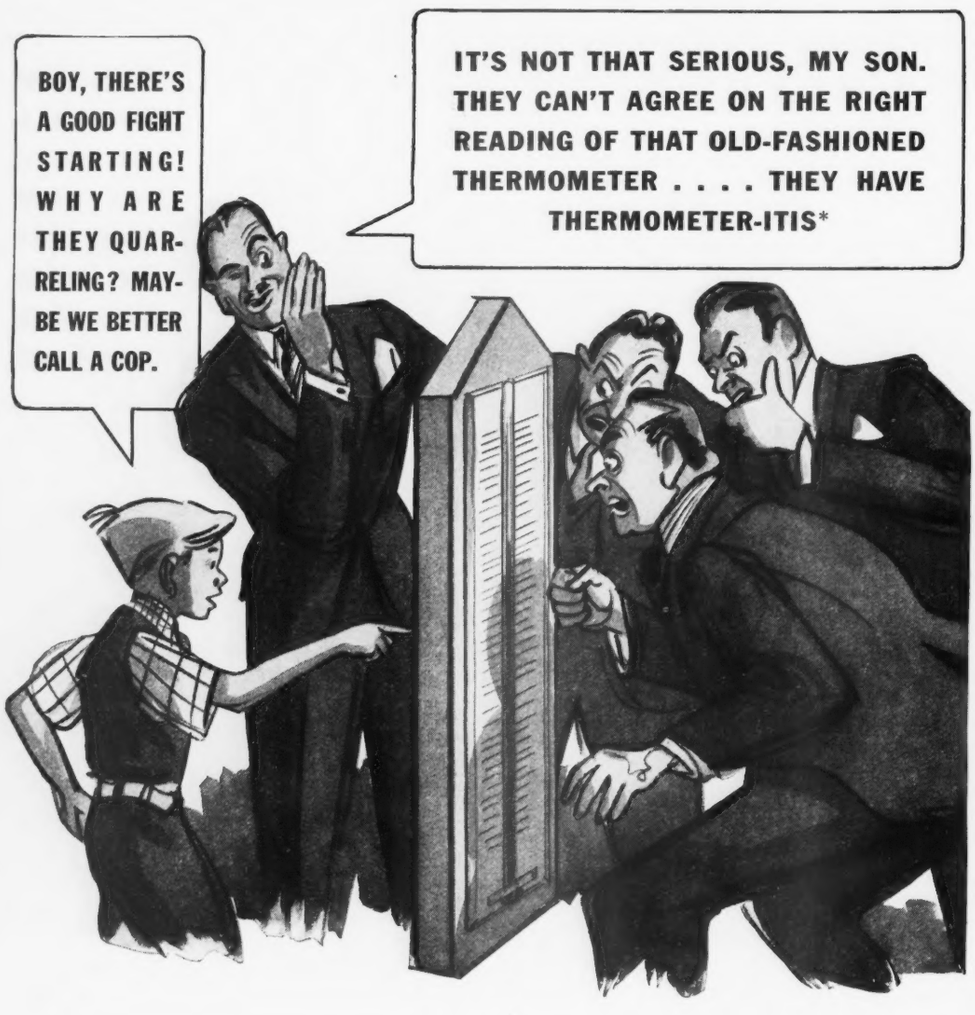
***MFMA** — This trade-mark on Maple Flooring guarantees that it conforms to the exacting grade standards of the Maple Flooring Manufacturers Association. It protects you against species substitution and inferior grade. It assures you of *genuine* Northern Hard Maple. Look for it on the flooring you buy.

MFMA Approved

NORTHERN HARD MAPLE IS THE LONGEST-WEARING COMFORTABLE FLOOR

Don't let your thermometers

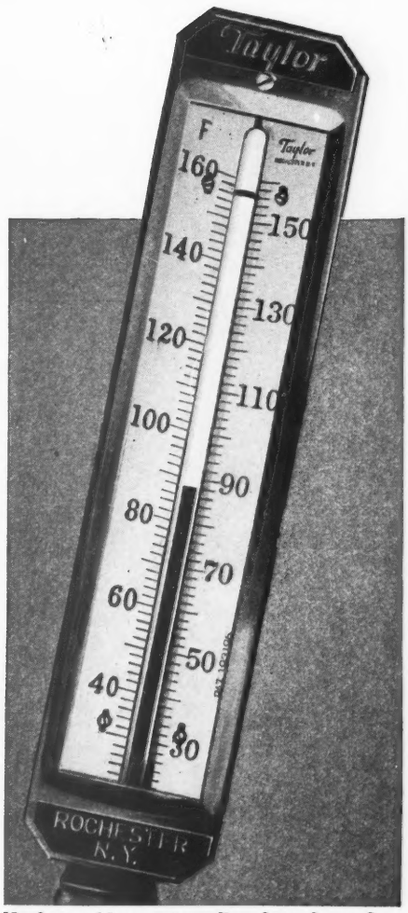
Bore reflections in old-fashioned industrial ther- have tricked many an honest employee. Taylor Tubing eliminate such reflections... show the one


BOY, THERE'S A GOOD FIGHT STARTING! WHY ARE THEY QUARRELING? MAYBE WE BETTER CALL A COP.
IT'S NOT THAT SERIOUS, MY SON. THEY CAN'T AGREE ON THE RIGHT READING OF THAT OLD-FASHIONED THERMOMETER . . . . THEY HAVE THERMOMETER-ITIS*

***THERMOMETER-ITIS**—caused by trying to see temperatures on hard-to-read thermometers. Recognized by squinting... seeing temperatures that are not there... acting as if nearsighted... moving head and body from side to side when making a reading.

FOOL YOU

mometers with single-lens tubing
Thermometers with triple-lens BINOC
correct temperature at every reading



No chance of inaccurate readings due to bore reflection with this bold, clearly defined mercury column. BINOC Tubing makes Taylor Thermometers as easy to read as a newspaper headline.

AS A MIRAGE has often tricked the senses of desert travelers, bore reflection in industrial thermometers of the past has deceived the the honest eyes of trained employees, and defeated quick, easy, accurate temperature readings. For in the attempt to make a reading from an improper angle, reflection in the empty bore above the mercury column has made the mercury appear higher than it actually was.

But now you can forget bore reflection ever existed. Taylor Engineers have killed it in their remarkable new development—BINOC Tubing. They evolved an optically correct glass tubing with a scientifically determined triple-lens front. The light which caused bore reflections is diverted or excluded.

Examine BINOC Tubing in a Taylor Thermometer. You will discover what many other plant executives have found—that the one quality industrial thermometers have always lacked before is now supplied by BINOC Tubing—EASY READING.

BINOC Tubing more than doubles the angle of vision within which you can see and read the mercury column. Its triple-lens construction concentrates more light, more intensely, on the column and makes it stand out in bold relief. BINOC Tubing makes Taylor Thermometers two to five times easier to read, yet it loses nothing in magnification.

BINOC Tubing gives Binocular Vision. It ends the need for close-range reading with one eye squinting. It assures accurate reading with great ease at longer distances—*with both eyes open.*

It will pay you to test Taylor Industrial Thermometers equipped with BINOC Tubing. See for yourself how this new development gives you quicker, more accurate readings, aids in eliminating costly mistakes, guards product uniformity and quality. For an immediate demonstration, ask a Taylor Representative or write direct to Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada.

Taylor
INDUSTRIAL THERMOMETERS
with BINOC *tubing*
REG. U. S. PAT. OFF.

GET NEW FEVER THERMOMETER WITH BINOC TUBING

After the development of BINOC Tubing for Industrial Thermometers Taylor turned its attention to the use of this remarkable product in fever thermometers. Taylor BINOC Fever Thermometers are now being introduced through the drug stores of the country. They have the same triple-lens construction that assures greater visibility. *They have shown that they are three times easier to read than other high quality fever thermometers.* The flattened tubing makes them easier to handle and more convenient to use. These remarkable new thermometers are as great an aid in the home as BINOC Industrial Thermometers are in industry.

If you want one of the new BINOC Fever Thermometers, and your druggist cannot supply you, just fill out the coupon, giving name of your regular druggist, and mail it with check or money order.

TAYLOR INSTRUMENT COMPANIES
Dept. FMM-11, Rochester, N. Y.

I enclose { check / money order } for the BINOC Fever Thermometer (oral type, with case) checked here. My regular druggist is

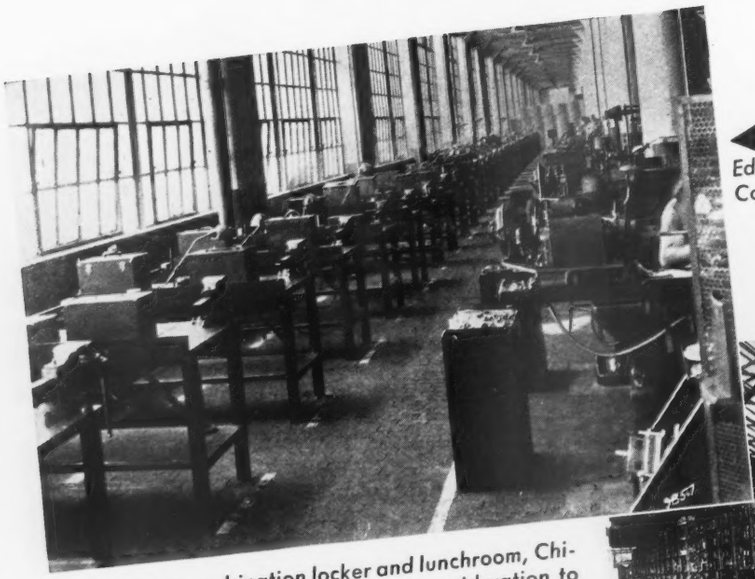
_____
(Name of retail store – and address)

_____ Taylor BINOC Fever Thermometer $1.50 each—
_____ Taylor-Tycos BINOC Fever Thermometer $2.00 each

Name _____

Address _____

City _____ State _____



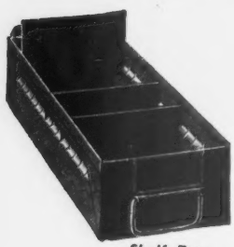
◀ Lyon Steel Shop Benches in the Edgewater, N. J. plant of Aluminum Corporation of America.

In planning this combination locker and lunchroom, Chicago Screw Company gave particular consideration to the factors of employee comfort and convenience, space conservation and maintenance costs . . . and selected Lyon Equipment throughout: Lockers, Benches and Tables.

▼

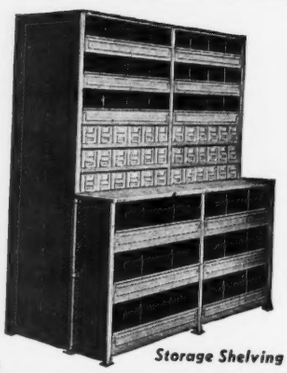
▲ Die Vault of Mills Novelty Company, Chicago; Lyon Steel Shelving is used for the safe storage and economical handling of more than 6,500 dies weighing 25 to 1,500 pounds. In this installation the Lyon Shelving built to sustain a load up to 15,000 pounds per section . . . provides 35% increase in capacity in same floor space over former rigid welded construction.

Shoprobes

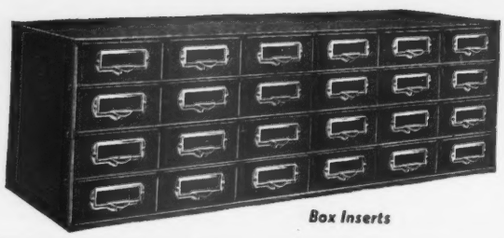


Shelf, Tote and Stacking Boxes

Steel Folding Chairs



Storage Shelving



Box Inserts

Shop Benches

Industrial Leaders

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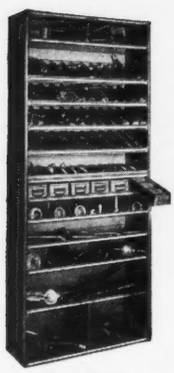

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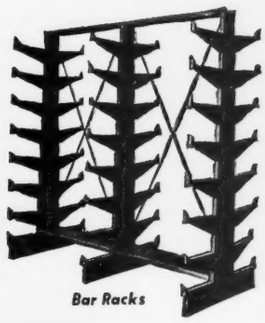

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Below. All parts are gauged for accuracy while in process of manufacture.

During his 26 years in engineering and manufacture, Charlie Williams has seen Reliance policies and ideals crystallized through decision and action. With a clear understanding of such intangibles he is well qualified to direct the work of guarding Reliance quality.

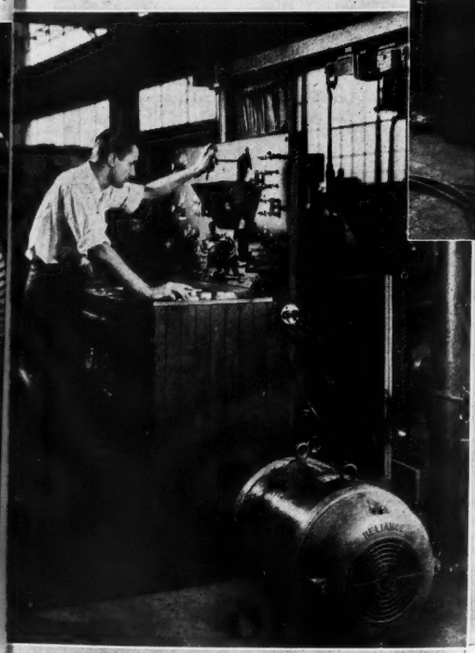
on Reliance *Quality*

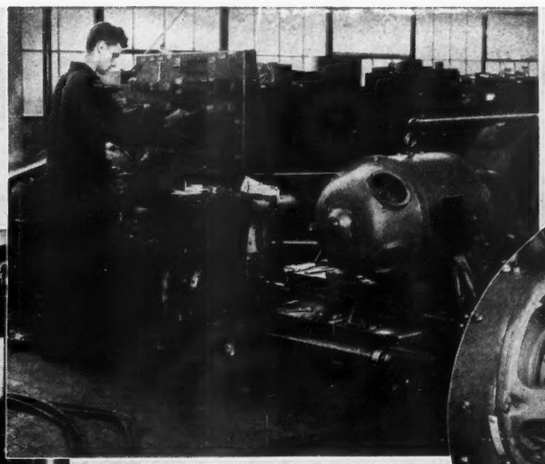
Because of a closely-knit organization we can do things at Reliance in unusual ways which put added value into our product. Here inspection and tests are in charge of the Engineering Department. In this way, *engineering* follows the motor from the point of design to the shipping floor. Raw materials, parts in process, and assembled units are constantly under the observation and control of men primarily interested in maintaining high standards of quality which have been set for Reliance Motors. It's never a case of "getting by" but of "making sure." Our inspection and test work is followed through on this basis.

C. R. Williams

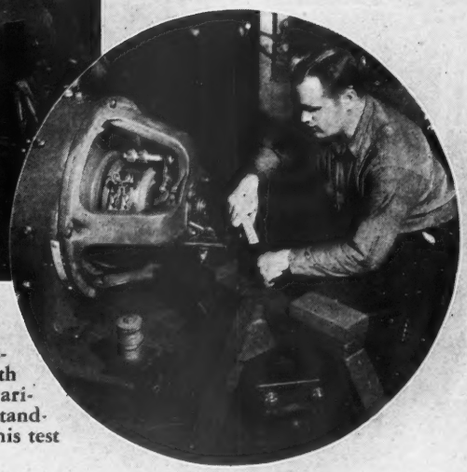
Engineer in Charge of Inspection and Tests

Below. A locked-rotor test given each alternating-current motor provides a definite check against standards which have been set for a particular rating.





Left. Every direct-current Reliance Motor is put through its paces *under load.*



Right. Care is taken to produce units which when assembled will insure a smooth running-balance. Any variation from established standards will be caught by this test with a vibrometer.

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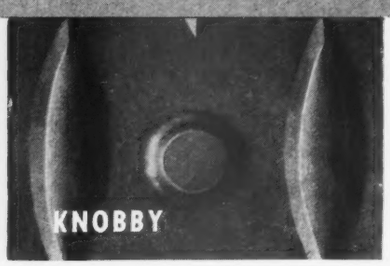

2 KNOBBY — Perfect foot support, recommended for heaviest traffic.

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Factory
Management and Maintenance

VOL. 95, NO. 11 — CONTENTS — NOVEMBER, 1937

Action Is Resumed on the Labor Front 53
An editorial

A Case in British Labor Relations 54
An idealistic labor philosophy practically applied

It's This Way in Washington 58
Carter Field tells what's what on Capitol Hill

How the Hand Behaves 59
Motion-study research—and how it is applied

Safety Can Be Made Popular 62
A page from a personnel man's notebook

Asked Employees How They Felt 63
Common-sense approach to a besetting problem

How Well Is Your Plant Run? 64
Ending a three-part analysis of management policies

2,750 Meals a Day—and in the Black 75
NCR runs kitchen like any factory department

Census of Manufactures 79
United States, 1929, 1933, 1935

Manufacturing Changes 80
United States, 1929–1937

Production, Man-Hours, and Earnings 81
Manufacturing Industries, United States, 1914–1937

Industrial Disputes 82
United States, 1929–1937

Cooling Down Absenteeism 83
Air conditioning steps up summer die production

Tunnels for Group Drives 84
Make room for overhead handling of materials

What Instruments Are Doing for the Other Fellow 86
They can do equally well for you

Door Open, But No Draft 88
Unit heater provides effective warm-air curtain

What Protection with Control? 89
Automatic vs. hand starting after voltage failure

They Profited by Raising Power Factor 90
A good way, incidentally, to cut production costs

When Wiring Your Plant 92
How to lay out secondary distribution systems

Rubber Is Our Friend 94
It protects metal parts from abrasion and acid

Some Oils Are More Oily 95
It makes a lot of difference in lubrication

How Much Power Factor Correction? 97
Data Sheet

Centrifugal Pumps 98
Data Sheet

You Want to Know 100

Operating Shorts 118
Signal System Gives Audible and Visible Alarms (118); Filing Cabinet for Graphic Instrument Charts (118); Ingenuity Simplifies Punchpress Repairs (118); Solder Pots on Casters (120); If You Need a Paint That Resists Acid Fumes (120); Making Floor-Plan Templets Stay Put (122); So You Won't Forget Where the Fire Extinguisher Is (122); Clamping Rings Hold Split Pulley Firmly on Shaft (122); Wrapping Cables Prevents Fire Spreading (122); Automatic Magnetic Brake for Small Motor Drives (124); Ground Wire Protects Pole Line from Lightning (126); Heat and Pressure Save Time in Altering Conveyor (128); Chain-Operated Switches Replaced Stop Buttons (130); Electric Heat for Isolated Factory Office (130); Cold Bath Speeds Paraffin Coating Operation (132)

Trade Literature 116

Questions and Answers 132

Sayings and Doings 136

Letters from the Editor 142

Books 166

FACTORY'S PLANT OPERATION LIBRARY—The Variable Budget 67–74

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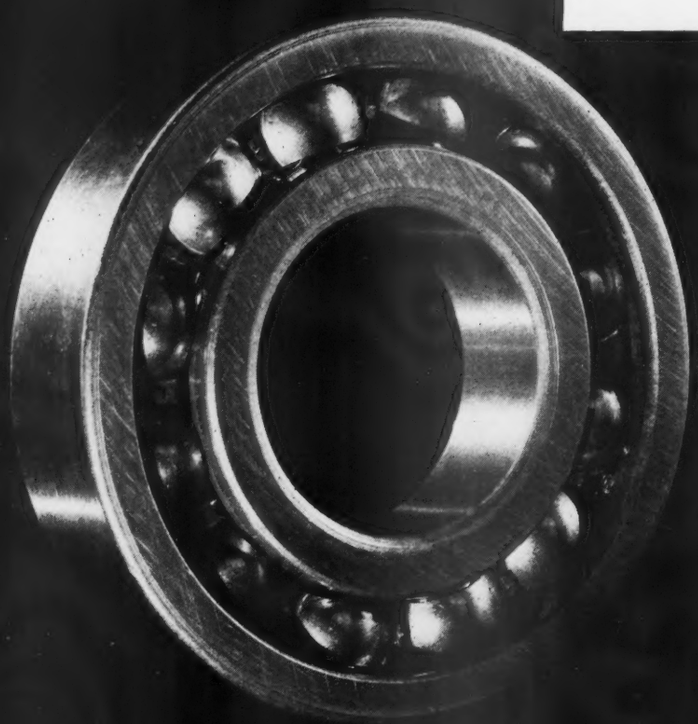

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NOTHING ROLLS LIKE A BALL

Factory
Management and Maintenance
L. C. MORROW, EDITOR

Action Is Resumed on the Labor Front

TWO OCCURRENCES of importance to industry are about to take place at this writing: (1) The Congress is to convene; (2) AFL and CIO are to have a peace meeting.

Early attention of Congress will be given to wages and hours legislation. Undoubtedly the President is correct in believing that he has a mandate to proceed along that line.

It is a question as to what form the new wages and hours bill will take. The original bill was terrible. The bill as revised by the Senate—the same bill that was stalled by the House Rules Committee—was bad enough, particularly after the House had added its 59 amendments. This bill, as well as the original, would have taken the first step toward government control of wages and hours, with the possibility of later control of prices. If we ever have price control (always accompanied by production control) it will be just too bad for a national economy based on private enterprise.

Industry's concern is to do all it can, first, to see that no monstrosity such as the original bill is allowed to pass; second, to see that whatever bill is passed should be as simple as possible.

There are good and bad features of an AFL-CIO get-together. So long as these two labor forces are warring, they are bound to have their differences with the National Labor Relations Board and their objections to the Wagner Act. If they create enough disturbance, they may bring about revision of the Act, an objective that the employer side of industry is not likely to achieve. After they smoke the peace pipe they will pipe down about both Board and Act.

COMPETITION between the AFL and CIO has brought about action by both to curry favor in public opinion. To illustrate, there is the resolution adopted last month by the CIO pledging the organization to respect its contracts. It is a fine resolution which would gain for organized labor the respect of industry and the public if lived up to. With the two factions joined, this resolution might become a scrap of paper.

Jurisdictional disputes and boycotts, of course, may be eliminated by the reunion. If they are, industry and labor and the public will gain. That is one good feature of the get-together. Another is that, in the long run, it will change an impossible situation wherein two major labor organizations are vying for control of the employees of industry.

A Case in British Labor Relations

Something of an idealistic labor philosophy and its practical application. Presented in the thought that we in America may learn from British experience

R. LLOYD ROBERTS
Chief Labor Officer
Imperial Chemical Industries Limited
London

AMERICAN AND BRITISH industrialists have at least one common and besetting problem — the adjustment of human relationships in industry. Your position in America is complicated, of course, by racial and economic factors that do not exist in Great Britain. Our methods of approach may be quite impracticable for you. Yet out of what we have done in my country there may emerge some one thing that will help you in your difficulties. If it does, I shall be well repaid for setting down here something of the techniques we have developed over the many years that we have been living with the problem.

In my own company we have nearly 50,000 manual workers spread over 55 factories. These factories vary from 10,000 employees down to 50 or so. In some of these factories there are no trade unionists; in others the workers are 100 per cent organized. Over all, however, I should say that less than 50 per cent are trade unionists. We deal with about 20 unions—3 of them representing the manufacturing and servicing departments, and the others the craftsmen and machinists employed on maintenance and construction work.

Our problem then is to keep a scattered payroll of 50,000 contented and to maintain friendly relations with 20 unions while, quite incidentally of course, managing our works and making a reasonable profit.

When we originally set out to face this problem, the first thing we did was to recognize that it could not be dealt with as a sideline—it must be treated as a major issue along lines just as deliberately studied and executed as those pertaining to technical and commercial matters.

All labor matters are therefore in the care of a specialized department responsible to the Board of the company. It is the duty of that department to secure the uniform administration of the Board's labor policy throughout all plants. It does so by means of group labor officers attached to the various manufacturing groups, and these group labor officers in turn have plant labor officers at each plant. The central department in London deals with the group labor officers, whose business it then is to insure that their plant labor officers carry out the company's policy in the individual plants. The plant labor officers are responsible to their respective plant managers for the proper conduct of labor relations in that plant.

The Four C's

We are of the opinion that no undertaking can expect harmonious industrial relations unless those relations are governed by a definite policy emanating from the Boardroom and are thoroughly understood and appreciated in regard to all its implications by the various ranks of management down the line.

The late E. K. Hall emphasized this to me nearly 20 years ago, and I have profited much by remembering what he described as the four C's — *contact, consultation, confidence,* and *cooperation.* In fact, these form the basis of my company's labor policy.

I have no need to remind that there can be alternative kinds of labor policies. One is based primarily on the theory that the wage packet is the only bond between the employee and the company. This conception of industrial relations is a purely materialistic one; those who adopt it assume that, in order to get the best out of a man, all you have to do is put more money into his pocket.

In my view the upholders of that policy are treading a dangerous path because they are appealing to the lowest instead of the highest instincts of the workman, and a relationship so based will inevitably lead to conflict sooner or later.

The other form of labor policy envisages a much nobler conception of human nature and the function of industry in our social economy. You may, if you like, term it the idealistic theory of industrial relations as opposed to the materialistic one. The basic idea is that industry exists to render service to the community and that it does so by means of the joint activities of the investor, the management, and the manual worker, each of the three parties naturally expecting to receive a fair reward for its contribution.

To my mind, this conception of industry must be frankly accepted for the future. If you ask me why, I refer you to the spread of education among the mass of the population.

The workman of 1937 is a very different individual from his predecessor of earlier generations. He now thinks for himself; he reads what others think; he listens to others who have read and thought more than he has. He now knows that he has a contribution to make; he realizes that labor is just as essential to industry as is the capital-

ist. And knowing all this, he demands what he thinks is his proper place in the scheme of things.

If the capitalistic structure of society is to continue, the believers in that structure must see to it that it can be adapted to meet these legitimate desires and ambitions of the workingman of today. Hence my company has adopted a labor policy appropriate to what we conceive to be the needs of our time.

With, Not For

Quite simply, we try to make the worker realize that he is working *with* the company rather than *for* it. We believe that only by the establishment of such an understanding with our people can we secure their intelligent cooperation to the fullest extent.

So much, then, for the philosophy underlying our behavior towards our people. We now come to the implications of that philosophy and to its practical expression.

First, we do not base our wage policy on the sole consideration of supply and demand. We have established a national minimum rate which we believe to be at the moment a fair rate in relation to our own prosperity and to the purchasing power of money. We are well aware that, in many of the areas in which our plants are situated, we could obtain labor at lower rates, but we decline to take advantage in any way of that fact.

We have, of course, many rates superior to the minimum, and because we are anxious that men should be paid appropriately for skill and responsibility we have for the past 16 months been engaged in a meticulous "point-rating" of all our jobs with a view to insuring (a) that we do not apply the minimum rate to other than laboring jobs and (b) that jobs superior to that of the laborer are correctly rated. This was entirely a voluntary undertaking on our part.

Another indication of our attitude is that we settle the general wage position at all factories by negotiation with the appropriate trade unions, even though — *and this is the important point* — those unions may not have a single member in a particular factory.

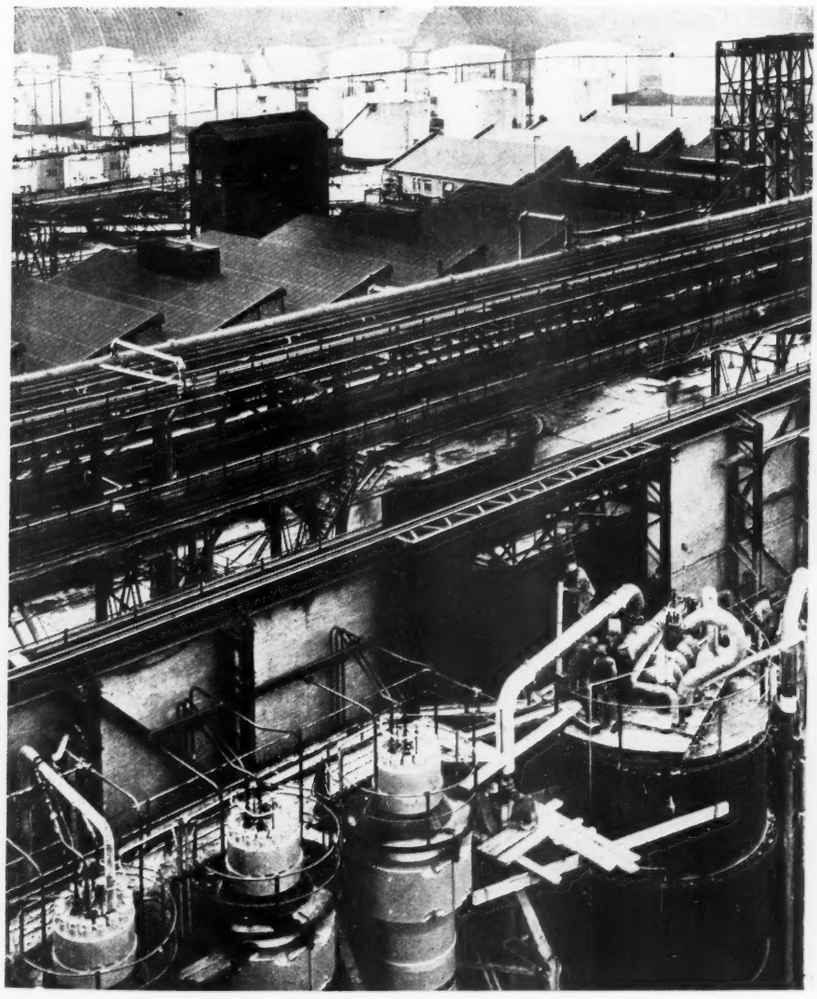
In our unorganized factories we could perfectly well settle wages and conditions direct with the workers themselves through our works council machinery. We do not do so, however, because we believe that those workers are not in any real sense in a fair economic position to bargain with us. We believe they need the protection afforded by trade unions and union officials who are experienced in wage negotiations and who know the general wage position in the country.

We believe that, however honest our intentions as a company, we need the salutary check on us imposed by these external bodies. We know that, having regard to the relations which exist between us and our workers, we could many times adjust wages and conditions against the workers, or refuse reasonable claims for improvement on the plea of necessity and because of their confidence in us they would readily submit. In order to prevent any possibility of abuse of this confidence, therefore, we invariably conduct such negotiations with the Unions and so submit to the challenge to make good our case.

Essential Sanity

This attitude towards trade unions is justified because of the essentially sane character of those unions. They are not all of equal sanity, of course, from my point of view—for example, when the Plumbers' Union claims that the fixing of concrete gutters is a plumber's work, because gutters used to be made of lead and all lead work belonged to the plumbers.

Broadly speaking, however, I can say that throughout my quarter of a century's experience the instances of unreasonableness on their part have been extraordinarily few. I except, of course, the period of the General Strike in 1926, when the attitude of all unions was abnormal. On that occasion, the various unions called out their members in my company, and in order to make sure that everybody would see the notices, I exhibited them in all departments. The response, however, must have



General view of the coal hydrogenation petrol plant at the Billingham Works of Imperial Chemical Industries

"The structure of the unions naturally develops what you might describe as a belligerent formation—workmen on one side, employers on the other. *We* spare no pains to convince *our* men that, far from being ranged on opposite sides as in battle, they and ourselves are allied in a common cause"

been disappointing to the unions, because not a man moved from his post—a noteworthy tribute to the relations between my company and its employees.

What I describe as the essential sanity of our unions towards my company has been to some extent induced by our treatment of them. We have frankly recognized their right to use every constitutional endeavor to improve the economic position of their members, and we have never refused them conference to discuss their claims. Further, they know that we have an efficient Labor Department motivated throughout by a desire to insure fair treatment.

On any major issue they know that the proposals of the Labor Department have been carefully examined by the Directors of the company and that any offer—for example of a wage increase—is a considered one and is not put forward as the first stage of a bargaining process where the unions gradually mitigate their demands and the employers gradually improve their offers until a compromise is reached. We do not proceed on that basis. We offer the amount we consider reasonable and adhere to it.

Two Hours to Settle

Only a month or two ago I met in conference the representatives of the eight unions representing our engineering craftsmen. The conference was held at their request to consider a claim by them for an advance in wages. They opened the conference by pointing to the prosperity of our company, the greatly increased trade activity, and the increase in the cost of living, and concluded with the remark:

"There's no need for us to make a lengthy series of speeches. We know you have considered our claim, and we should now like very much to hear from you."

I then reminded them that much of our present national trade activity was abnormal, being induced by the government's armament program, that we had obviously entered on a period of artificial conditions, and that consequently we did not consider it desirable to interfere with the standard rates of wages. We were, however, prepared to grant a bonus on earnings of 6¼ per cent. The conference commenced at 11 a.m. and finished at 1 p.m., our offer having been accepted in its entirety, at a cost to my company of some $300,000 a year. We then adjourned to lunch under the chairmanship of one of my Directors.

That was an easy conference, but believe me we do have the other sort —when we go on all day and then adjourn, meet again and again, and still disagree.

For instance, there is the question of recognition of shop stewards—an issue on which we are quite firmly in disagreement, but one the unions nevertheless raise from time to time. We have even had unconstitutional strike notices tendered on this issue, but that does not alter the relations between the unions and ourselves. They recognize that there must be questions on which we disagree with them, and they have learned to appreciate that when we say "Yes" we mean "Yes", and when we say "No" we mean "No".

This atmosphere of confidence was not built up only in formal conferences. It is the result of both parties meeting in an informal way when there is no special business to discuss and no shorthand writers are present. It might almost be true to say that my own main business is to know the officials of the various unions in this way and to give them opportunities of knowing me and my Directors.

Not a week passes without my having these informal contacts with one or other of these officials, and periodically they lunch with my Chairman and the Directors. On these informal occasions, much is said that enlightens the unions on our general point of view, and we in turn are given a glimpse of the problems with which they are faced in dealing with their members.

It is similarly the duty of our group and plant labor officers to know in the same way the local officials with whom they have official contacts.

I cannot emphasize too strongly the value of our getting to know the union leaders and of treating them in a frank and friendly manner. Let me add that we have achieved this friendly relationship in spite of the fact that our attitude on more than one question is deeply resented by the unions. They do not like our Works Councils; they do not like our Staff Grade scheme; they have little love for our Pension Plan and our Friendly Society—all these things in their view tend to bind our employees to us and to make them less willing to take concerted action with their fellow-workmen elsewhere.

There is little doubt that our men *are* a source of disturbance within the ranks of the unions. They are members of the same lodges as men employed elsewhere, and naturally their preferred position in enjoyment of these various privileges creates jealousies.

It is also undoubtedly true that our men are, for the most part, less ardent trade unionists by reason of the conditions of their employment, and it is therefore not to be wondered at that the unions view our doings with some hostility.

Employees First

The difficulty is not minimized by our insistence on regarding the workers as our employees first, and only secondly as trade unionists. We insist on the most complete direct contact with our people—we talk to them direct, we remedy their grievances direct, and of course we give every possible encouragement to them to talk to us direct—except on matters of wages and basic conditions.

The unions, on the other hand, would like us—as they put it—to talk to their members through them, in order to sustain and increase their influence with their members. The contrary is our definite policy. We regard our men and ourselves as the natural allies, and we regard it as a mark of some inefficiency on our part if one of our men has to go to his professional organization—the trade union—to get a grievance corrected.

The structure of the unions naturally develops what you might de-

scribe as a belligerent formation—workmen on one side and employers on the other. *We* spare no pains to convince *our* men that, far from being ranged on opposite sides as in battle, they and ourselves are allied in a common cause.

In other words, we emphasize the community of interest between us to strengthen our men against those external influences who preach the inevitability of conflict between employers and employed.

I have made it plain, I hope, that the existence of our good relations with the unions does not mean that we allow them to manage our works for us. Our position with them is clear. We welcome them as bargaining agencies on matters of wages and basic working conditions. We welcome, too, from them any representations they may wish to make on matters of management, such as the engagement or dismissal of workers, but we do not negotiate with them on such matters. We do not allow any interference with the functions of management that consist in the ordering of the plant in such a way as to secure efficient production. It is evidence of that sanity among the unions of which I have spoken that there is on their part very rarely any attempt to cross this border line.

Tell the Unions All

We also present to the unions for their criticism a draft of any plan we may have for additional privileges beyond ordinary customary working conditions—for example, the Pension Plan, the Friendly Society, etc. They would like such things to be issued as matters of joint agreement for the enhancement of their prestige among their members. We point out, however, that those who become parties to any such plan must naturally share the financial commitments involved in the plan, and that effectively disposes of that particular trouble.

Finally, it is a fixed policy with us not to negotiate with more than one union for the same class of employee. For example, if in one plant we have customarily negotiated with a certain general union for the process men, we will not admit claims from either of the other general unions. To do so would obviously encourage men to switch over continually from one union to another in the hope of greater benefits, and we would be attacked by both in turn.

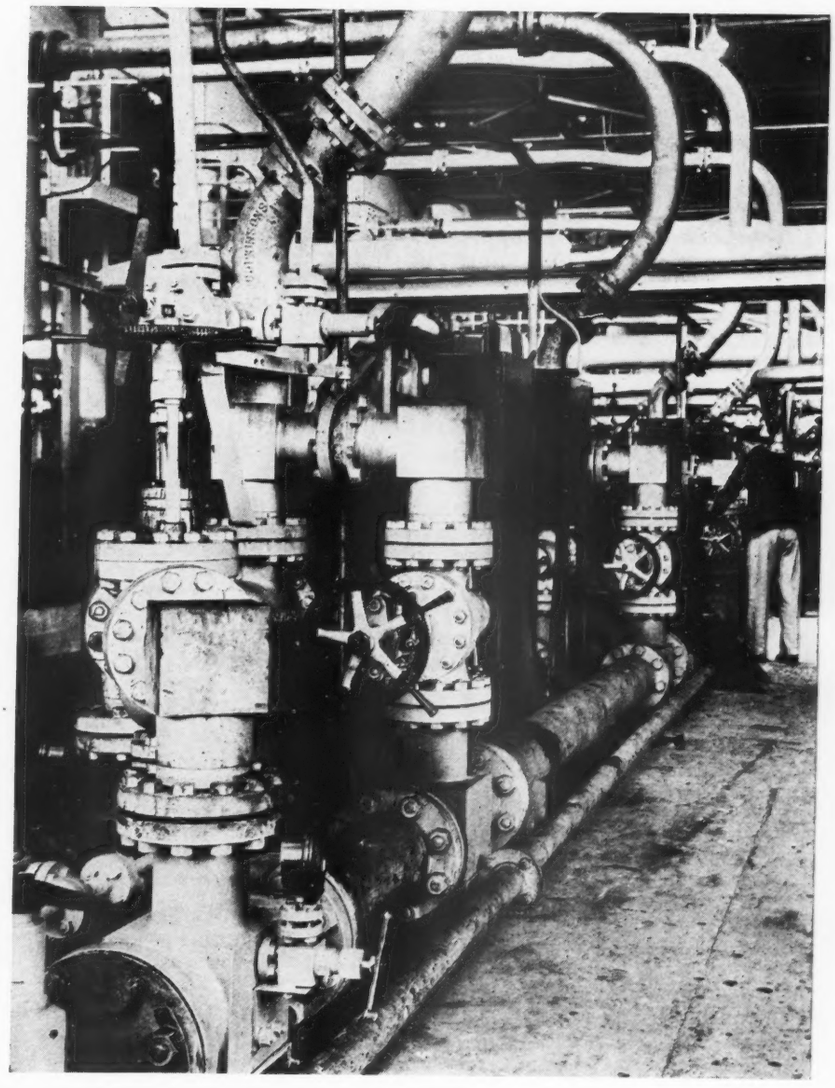
Similarly, we know that some of our electricians are in one union, some in another. We say we are only going to negotiate with one, and as a result we now have an arrangement with all the unions that when the membership of more than one union may be affected by any claim, that claim shall be submitted as a joint claim by all the unions who might be affected. That prevents our receiving competing claims from unions catering for the same class of worker and also prevents any repudiation by one union of a settlement reached with another.

As the result of this arrangement, our wage negotiations are now considerably simplified. We have one national joint agreement with the three unions catering for the process operators and laborers, one with the seven unions representing the building craftsmen, and one with the eight unions representing our engineering workers. We also have similar agreements with the Coopers' and Wagon Repairers' Unions, separate because they do not fall into any of the main categories.

All these agreements deal with wages only and provide that if any changes in working conditions—e.g., overtime rates, etc.—are contemplated, such changes shall be effected in joint conference with the parties to all the agreements, thus again preventing competing claims.

One other feature about union negotiations: In making national agreements we were alive to the advantage of conducting major negotiations between our respective

(*Continued on page 148*)



Pipes and valves of hydraulic system controlling the direct operating coal-paste injections in the I.C.I. petrol plant at Billingham

It's this way in Washington

Harris & Ewing

CARTER FIELD

Washington Correspondent

Complications lie ahead of wage and hour legislation. Its opponents are as strong as ever. Some of its proponents are cooling off. Organized labor likes it none too well. But try to find a Washington observer who will bet against its eventual enactment into law

JUST ONE REMOTE possibility may prevent passage of the wages and hours bill. This is if the AFL and the CIO should join hands in decreeing its death. But this is so unlikely that it should not be included in employers' calculations.

The possibility must be mentioned because actually the labor leaders in both camps have no use for the bill. Down in their hearts they would like to see it sidetracked. But it would embarrass them no end to come right out and say so. It would lend color to the charge so often made by critics that labor leaders are interested in their own jobs, perquisites, and power, and do not care a rap really about the men and women in whose behalf they are always publicly beating their breasts.

Fiat for Threats

The obvious fact, of course, is that this Fair Labor Standards Act, the late NRA, and every other move in this direction—always excepting the Wagner Labor Law—tend in the direction of making labor unions less useful to their members, of substituting government fiat for skillful negotiations and threats by union leaders in getting just rewards for labor.

Vivid light is thrown on this attitude by the recent discussions of the AFL Denver convention. The whole idea of the Black-Connery Bill as originally introduced, it was stated in the language of a resolution actually adopted, was to establish the precedent that "fixing wages was a natural and proper function for politicians and law-makers." Subscribing heartily to the theory that the government should establish maximum hours, the resolution sought to retain for collective bargaining the power of fixing wages.

Meanwhile private conversations of CIO leaders have been almost as critical of the Black-Connery Bill, although of course with no such slighting reference to the Labor Relations Board.

All this is cited to show that the latent opposition is there. The desire to kill the bill exists in the minds of persons who have the power to kill it. This power to kill is freely admitted in private conversations by advocates of the measure in the House and Senate—men who are predicting that beyond question the bill will pass. But congressional leaders do not believe labor leaders would dare apply the ax, and most observers agree.

Probability is that labor will accept the revision of the measure effected at the eleventh hour of the last session by William Green, which in effect restricted the enforcing authority—the board—from meddling in situations where the number of hours in dispute was *under* the legally set up maximum, or where the amount of wages involved was *above* the legally set up minimum. These restrictions leave more freedom for collective bargaining.

These amendments, however, were what increased the heat of the opposition last session that kept the measure in a House Rules Committee pigeonhole.

Rightly or wrongly, these changes were construed to bar the board from sectional differentials. So the Southern lumber men and small industries generally rose up and brought such pressure that most Washington newspaper men voted afterwards in a questionnaire that the blocking of this measure was the "major upset" of the entire session of Congress—not excepting the President's defeat on the Court.

There is really no doubt now that the bill can be dislodged from the Rules Committee, probably of the Committee's own will, but if not then by a petition signed by 218 House members. The real question is how far the Southerners will get in their fight for sectional differentials, or rather in reserving the power for the board to make such differentials.

It is not only economics—that the Southern employers of small sawmills and factories regard eliminating the present differentials as putting them out of business—but the race question also enters into it. As they see it this law, unless the differentials can be maintained, unsettles the negro labor problem from the Potomac to the Gulf of Mexico.

As this is written the Cotton Textile Institute has not acted, but it is certainly drifting against the measure. Last session it was the one big Southern factor for the bill. But its members are cooling. They are worried about other complications—the big cotton crop, social security and undistributed profit, coming crop control, probable processing taxes, and a host of other things. It would surprise no one to see this powerful group line up with other opponents of the measure *unless* the door is kept open for the aforesaid sectional differential.

But if the advocates of the differential win, that will increase by just that much the distaste of the labor union leaders for the whole measure. It might even provide the necessary public excuse for them to turn thumbs down on it.

And the Lamneck Bill

Another complication is the Lamneck bill. This embraces the ideas of Donald Richberg, Assistant Secretary of Commerce Ernest G. Draper, and several others. There have been several "authentic" tips that the Lamneck bill was to be the compromise.

Pay no attention to them! The essential feature of the Lamneck bill is to permit the industry to write its own terms, as a sort of code, with such restrictions on wages and hours as it might decide. But President Roosevelt has no sympathy with the idea of permitting an industry to "write its own ticket," and obviously nothing is going to be done about any wages and hours legislation to which the President is opposed.

How the Hand Behaves

First findings of a research in some elemental hand motions; their practical application to a simple factory operation, to the tune of 45 per cent saved

RALPH M. BARNES
Professor of Industrial Engineering
University of Iowa

FEW ATTEMPTS have been made in this country to discover fundamental data common to all kinds of manual work. Our Motion and Time Study Laboratory has, however, undertaken a program with just such objectives.

The purpose of this investigation was to discover and measure the component parts of some simple movements of the right hand—*transport loaded* (away from the body), *stop and change direction*, and *transport loaded* (toward the body).

Although micromotion-study technique is satisfactory for most studies of hand motions, it is not entirely so for those requiring the greatest precision. It was therefore apparent that the first requirement was a device capable of measuring and recording movements of very short duration—as short as a thousandth of a second.

The method using the kymograph principle was finally selected as being most suitable. Apparatus was constructed to record hand motions on the surface of a sheet of paper moving at a uniform and known velocity across a table top.

The apparatus, in its final form, is shown in Figure 1. Newsprint was drawn from a supply roll across the top of a table between two rollers. The bottom roller was driven by a synchronous motor through a chain of gears. Friction, as well as small sharp teeth projecting radially from the bottom roller, prevented the paper from slipping.

The bottom roller rotated at a constant speed of 60 r.p.m. Its effective circumference was 31.9 in.; consequently the peripheral speed of the roller, and also the speed of the paper, was 31.9 in. per second. A special scale was made with 100 divisions to 3.19 in.; therefore one division or 0.0319 in. equaled one thousandth of a second. As distances of 0.03 in. can be easily read with the naked eye, actual readings could thus be made to at least the nearest thousandth.

A Space-Time Curve

Now if a paper moves with constant velocity across a table, and if a pencil point is drawn across the paper in a direction perpendicular to the path of the paper, the resulting mark will be a space-time curve. The slope of the curve at any point will be the velocity of the pencil point at that point.

The first investigation was of a controlled "back and forth" motion of the right hand directly away from and toward the operator. After having grasped the button on top of the pencil carriage, *B*, with the thumb and index finger, the operator moved the carriage back and forth on the slide, *A*, between the stops. These variables were introduced:

1. Direction of motion
   - A. Away from operator
   - B. Toward operator
   - C. Stop and change direction
2. Hand travel
   - A. 5 inches
   - B. 10 inches
   - C. 15 inches
3. Kind of stop at end of motion
   - A. Mechanical—i.e., a positive stop of the carriage against the pin in the slide
   - B. Visual—i.e., matching the mark on the carriage with the mark on the slide

The carriage was fitted to move on a slide in order to restrict the hand motion. This permitted the investigator to hold all conditions constant except the one being studied. The slide was fastened at each end of the table top with clearance for the paper to pass under it.

Four things were clearly shown by

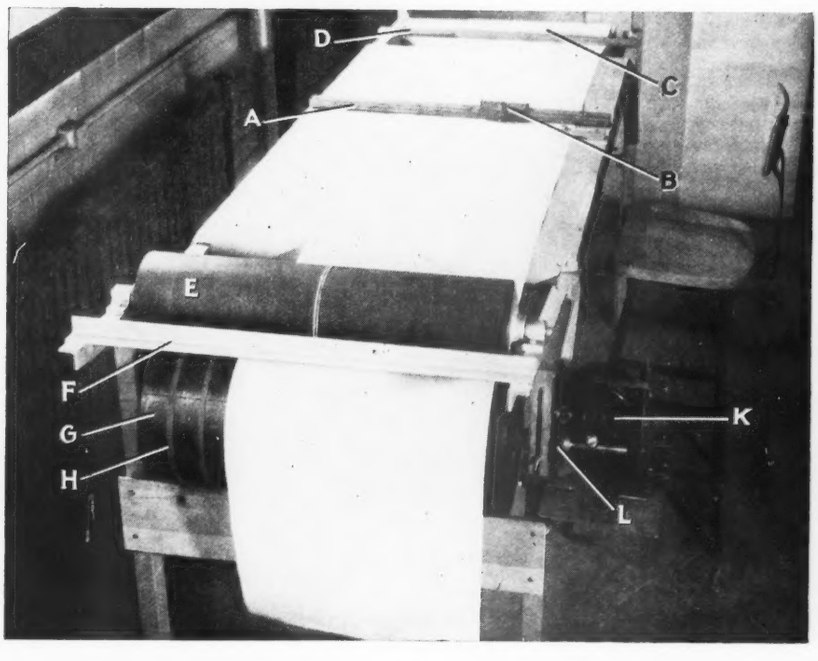


Figure 1. Apparatus for timing and recording movements of the hand. *A*, oak slide; *B*, pencil carriage; *C*, supply roll of newsprint; *D*, paper guide; *E*, idle roller; *F*, hinged angle-iron frame; *G*, drive roller; *H*, heavy rubber bands glued to drive roller; *K*, synchronous motor; *L*, gear drive

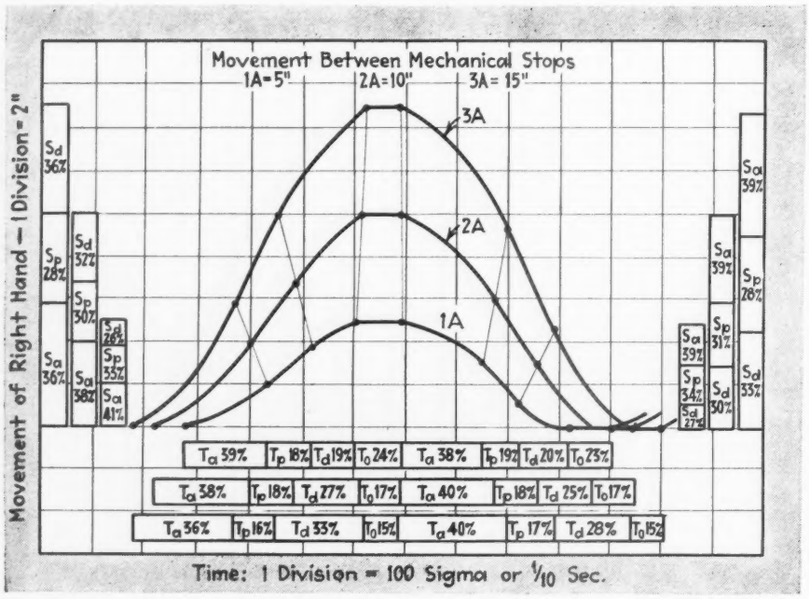


Figure 2. Curves showing movement of right hand through varying distances between mechanical stops

sample curves that were obtained. In every motion of the hand there was a definite period of acceleration, of constant velocity, of retardation or deceleration, and of changing direction. The period of acceleration or deceleration was shown by a curved line, the period of constant velocity by a straight inclined line, and the period of changing direction by a straight horizontal line.

A summary of the results is shown in Table 1 and in Figure 2. The following conclusions are based on them:

1. When length of motion is doubled (from 5 to 10 in.), time required to make the motion is increased 13 per cent for mechanical stops and 8 per cent for visual stops.

2. When length of motion is trebled (from 5 to 15 in.), time required is increased 25 per cent for mechanical and 19 for visual stops.

3. Approximately 38 per cent of total time for a motion is required for acceleration irrespective of length or type of motion.

4. Approximately 17 per cent of total time is required for motion at constant velocity. (Time for motion at constant velocity is independent of kind of stop, but varies from 18 to 16 per cent when length of motion is increased from 5 to 15 inches.)

5. Approximately 40 per cent of total time is required for deceleration for all distances when visual stops are used. When mechanical stops are used, time to decelerate increases from 20 to 30 per cent when distance is increased from 5 to 15 inches.

6. Percentage of total time required for changing direction decreases from 24 to 15 per cent for mechanical stops

Table I. Average Results of 28 Operators Studied

The upper values for curves of the same type are for movement away from the operator; the lower for movement toward the operator.

Upper values—movement away from operator
Lower values—movement toward the operator

	TIME in thousandths of a sec.					DISTANCE in inches				VELOCITY inches/sec.		RATIO	T_a, T_p, T_d, T_o in percent of total time				S_a, S_p, S_d in per cent of total distance		
Curve Type	T_a	T_p	T_d	T_o	T	S_a	S_p	S_d	S	V_p	V	V_p/V	T_a/T	T_p/T	T_d/T	T_o/T	S_a/S	S_p/S	S_d/S
1A	157	73	78	95	403	2.05	1.63	1.32	5.00	22.3	12.4	1.8	38.9	18.1	19.4	23.6	41.0	32.6	26.4
1A	155	76	84	94	409	1.94	1.70	1.36	5.00	22.4	12.2	1.84	37.9	18.6	20.5	23.0	38.8	34.0	27.2
1B	179	88	184	36	487	1.78	1.47	1.77	5.02	16.7	10.3	1.62	36.7	18.1	37.8	7.4	35.5	29.3	35.2
1B	184	86	184	38	492	1.71	1.51	1.77	4.99	17.6	10.1	1.74	37.4	17.5	37.4	7.7	34.3	30.2	35.5
2A	174	82	127	81	464	3.76	2.97	3.27	10.00	36.2	21.6	1.68	37.5	17.7	27.4	17 4	37.6	2.97	32.7
2A	178	82	115	77	452	3.96	3.07	2.97	10.00	37.4	22.1	1.69	39.5	18.1	25.4	17.0	39.6	30.7	29.7
2B	197	89	215	26	527	3.53	2.85	3.70	10.08	32.0	20.5	1.56	37.4	16.9	40.8	4.9	35.0	28.2	36.8
2B	211	91	195	33	530	3.73	2.83	3.50	10.06	31.1	20.0	1.55	39.8	17.2	36.8	6.2	37.0	28.1	34.9
3A	184	83	170	74	511	5.34	4.08	5.35	14.77	49.2	28.9	1.70	36.0	16.2	33.3	14.5	36.2	27.6	36.2
3A	202	87	139	75	503	5.70	4.20	4.87	14.77	48.3	29.4	1.70	40.2	17.3	27.6	14.9	38.6	28.4	33.0
3B	216	91	251	27	585	5.15	3.93	5.90	14.98	43.2	25.6	1.69	36.9	15.6	42.9	4.6	34.4	26.2	39.4
3B	239	96	218	30	583	5.80	4.20	4.87	14.87	43.7	25.5	1.71	41.0	16.5	37.4	5.1	39.2	28.0	32.8

1A Movement on slide Mechanical stops 5″
2A Movement on slide Mechanical stops 10″
3A Movement on slide Mechanical stops 15″
1B Movement on slide Visual stops 5″
2B Movement on slide Visual stops 10″
3B Movement on slide Visual stops 15″

Subscript $_a$ denotes period of acceleration.
Subscript $_p$ denotes period of constant velocity.
Subscript $_d$ denotes period of deceleration.
Subscript $_o$ denotes period of changing direction.
No subscript denotes total element for one-half cycle.

and from 8 to 5 per cent for visual stops when length of motion is increased from 5 to 15 inches.

7. Motions using visual stops require on the average 17 per cent more time than motions using mechanical stops.

8. Approximately 38 per cent of total length of hand motion is required for acceleration irrespective of length or type of motion.

9. Percentage of total distance required for motion at constant velocity decreases from approximately 33 to 28 per cent for mechanical stops and from 30 to 27 per cent for visual stops when length of motion is increased from 5 to 15 inches.

10. Approximately 36 per cent of total distance or length of hand motion is required for retardation (or deceleration) for visual stops; and varies from 27 to 35 per cent for mechanical stops as motion is increased from 5 to 15 inches.

Although there are a number of practical applications that might be made of the findings of the above investigation, only one will be considered here. It is: *Continuous curved motions should be used instead of abrupt changes in direction of the hand.*

Practical Application

Data in Table I show that from 5 to 24 per cent of the cycle time is required for "change direction." Because of the relatively large proportion of total cycle time used for "change direction," and because of the many places in industrial work where this information can be used to excellent advantage, this example is included.

The operation chosen for practical application is that of folding rectangular sheets of paper in the middle. The sheets vary in size from 3 x 5 to 12 x 15 in. folded. Although several million of these sheets of paper are folded per year, it was found to be more economical to fold them by hand than by machine because of the many different sizes that are used.

Two Creasing Motions

Old Method—The operator, holding a smooth piece of bone in palm of right hand (Figure 3) grasped lower right-hand corner (*A*) of sheet of paper to be folded. She folded this end over to point *B* where the two hands matched or lined up the two corners. Then, swinging right hand away from body and using bone as creasing tool, she struck folded sheet of paper at *C*, creasing fold from *C* to *D*. At *D* she stopped and changed direction abruptly, doubled back, creasing entire length of fold from *D* to *E*. At *E* the hand again changed direction and swung around to *F* where end of bone was inserted under edge of creased sheet to assist left hand in disposing of it onto pile of folded sheets at *G*.

Now a Single Motion

Improved Method — Operator grasps lower right-hand corner (at *A*) of the sheet of paper to be folded. (See Figure 4.) She folds this end over to point *B* where the two hands match or line up the two corners. She then moves right hand through a smooth "S" curve, the bone striking the paper and beginning to crease at *X* and ending at *Y*. Thus entire crease is completed with single stroke. Hand then swings around in curved motion from *Y* to *Z* where, as in old method, end of bone is inserted under creased sheet to assist left hand in disposing of it onto pile of folded sheets at *G*.

A 45 Per Cent Saving

Results—By using the improved method described above, only one creasing motion was required to complete the cycle instead of two (one short and one long one). Moreover, in the improved method two curved motions of the hand were used instead of two complete change directions and one 90 deg. change direction in the old method.

A micromotion study of these two methods shows that 0.009 min. was required to crease the fold by the old method and 0.005 min. by the improved method—a 45 per cent saving. The improved method of creasing the fold plus some other changes reduced total time from 0.058 to 0.033 min. per cycle.

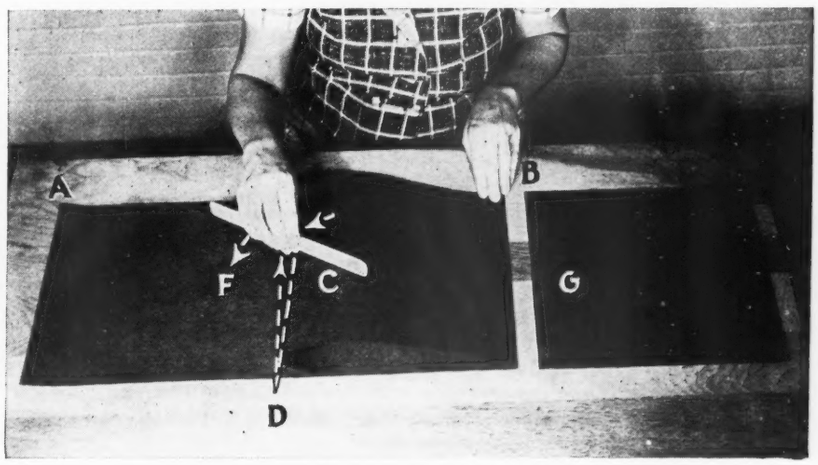


Fig. 3. Old method of creasing folded sheet of paper required two creasing motions—one long, one short

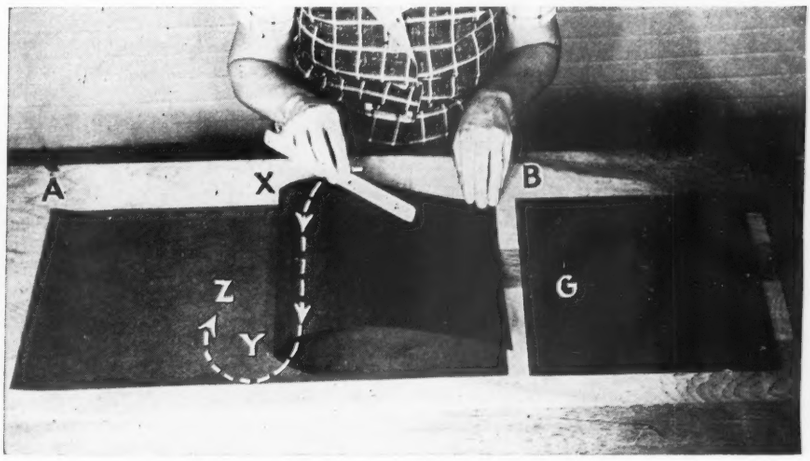


Figure 4. New method requires a single creasing motion, and micromotion study shows a time saving of 45 per cent

. . . in danger of becoming bug-eyed from trying to study all of them

Safety Can Be Made Popular

JOHN RICHELSEN
Personnel Director
Vanadium Corporation of America
Niagara Falls, N. Y.

SOME OF US talk safety till we're blue in the face. Our efforts seem at times to make a ten-strike. Then again they seem to end in a resounding flop.

The subject of safety can become an awful bore to those who have to listen. Strange as it may seem, men can and often do take a slant of resentment against the idea of being protected from accidents.

Giving prizes to men for safety records is established practice. We all do it. But there is no doubt that sometimes by a queer kink of human nature men get it into their heads that the company pays them for working safely only for the purpose of saving the company money. And of course it *does* save money.

For employees to have such a one-sided notion, however, is perilous for the men themselves, particularly when it is allied to a devil-may-care spirit that the company will have to help the men anyway if they happen to get hurt.

Safety *can* be made popular. The personnel director doesn't lack for ready-made programs, suggestions, stunts, and contests. They come to his desk by the dozen. Safety men are in danger of becoming bug-eyed from trying to study all of them. The task is to choose the plans that will likely be most effective under given conditions, and will be received by the employees with the right mental reactions.

Training classes for the study of first aid, for instance, can be made so popular that men will gladly give 15 hours of their own time to this schooling. The approach has been effective when based on the self-interest of the men. Make it a topic of conversation that a knowledge of the pressure points for stopping bleeding and the technique for inducing artificial respiration are easily learned and might prove of life-saving benefit for an employee of the company and his family.

A Wee Bit of Strategy

Nothing need be said about the plant. Then the dropping of a hint that the first aid department might be induced to give such a course is likely to register an enthusiastic response.

There is nothing astute in this approach. It is no more than common sense. The right mental reaction so often makes all the difference between conspicuous success and downright failure in safety work.

I am thinking here in terms of the smaller plants and their personnel directors who often, like myself, have to find their own way as best they may. It need not be emphasized that first aid training classes, though ostensibly for out-of-the-plant purposes, do much to promote safety in the plant itself.

The Vanadium Corporation recently put on a three-act safety play. The script was written by our own men; built up scene by scene and act by act on safety suggestions offered by the men themselves. The actors were all company employees, with office men and chemists barred.

It wasn't too bad, and the local press said a good time was had by all. The play was produced before a dinner gathering of our foremen and sub-foremen and then was put on for the Foremen's Club of Niagara Falls. The histrionic skill may have been rather lousy. The script was certainly a long way from Eugene O'Neill. But we accomplished what we went after—renewed safety consciousness in our plant.

Safety *can* be made easy to take. It is better to tie up safety propaganda with the self-interest of the employees than to impose it as a duty, except in extreme cases where discipline is imperative. If a personnel director has all his buttons, he will devise the sensible approaches for making safety popular.

Asked Employees How They Felt

One man can't sashay around and ask 100, 200, 2,000 men how they feel about this and that. They wouldn't tell him anyway. So why not the Armstrong method?

LEWIS K. URQUHART
Associate Editor

PLANT OPERATING men in general agree that most of industry's industrial relations problems could be handled a whole lot better if only management had some way of knowing what's on the employee's mind.

With this in view the Armstrong Cork Company sent out the little booklet shown at the bottom of the page.

"Because our company is so large," it begins, "the officers from Lancaster cannot chat with all of us personally. So this booklet has been prepared to give us a chance to express our opinion on many policies and plans.

"Is the company doing everything it can to help us get what we want from our jobs? Have we any suggestions that might help us in our work and make our lives happier?

"Succeeding pages in this booklet contain questions on a number of subjects. We don't have to sign our names. We don't even have to hand this in unless we care to.

"Every one of us will get one of these booklets, from the president right down the line. Let's be frank. If we are proud of our company, let's say so. If we have something on our chests, here's a chance to get it off."

Took Them Apart

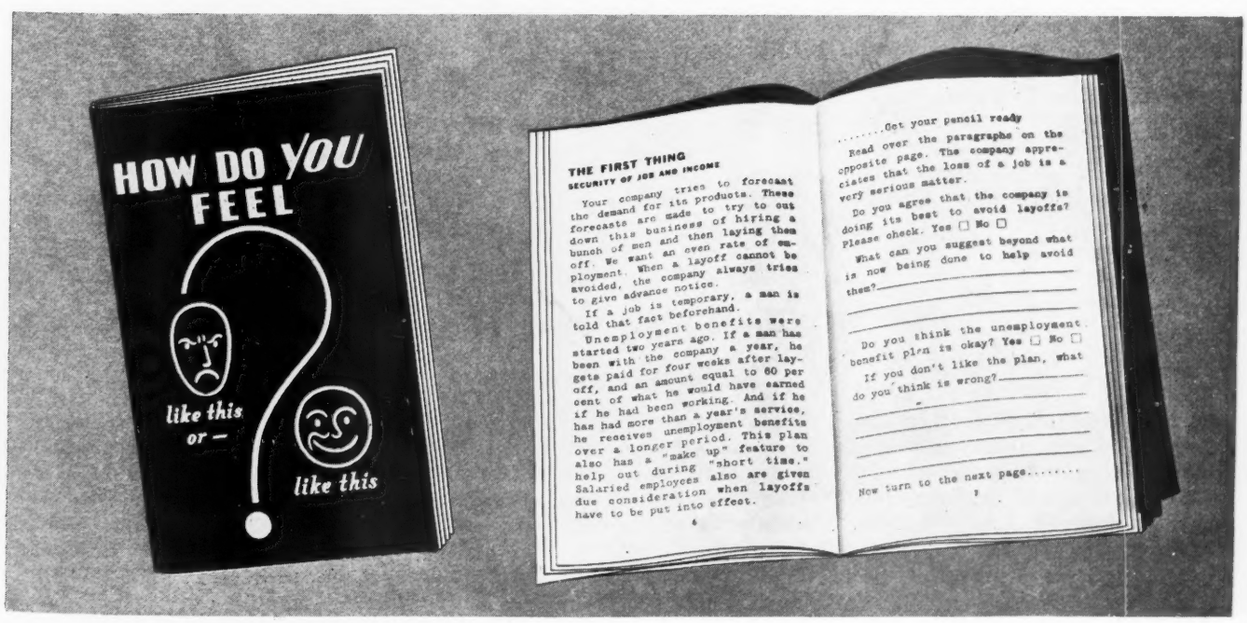
Next, Armstrong lists the "Seven things you want from your job":

1. Security of job and income
2. A fair wage for work performed
3. Safe, orderly workplaces
4. Pride in the policies, products, and progress of your company
5. Reasonable working hours affording enough time for relaxation
6. Knowledge of what your company is doing and an opportunity to express your opinion freely
7. An opportunity for you to be prepared in case of sickness, accident, disability, or death, and to provide an income for your declining years.

Each of these seven things is then "taken apart" in the pages that follow. How the first of the seven is treated, is shown in the pair of pages illustrated.

When the returns are all in, the company is going to have an accurate picture of the employees' attitude. Few "crabbing" replies have come in. Many employees have signed their names. Already it is obvious that a lot of them do not fully understand the company's personnel program—its retirement plan, for instance. There is just one thing that can be straightened out right away.

Below, the booklet Armstrong Cork Company distributed, asking employees for their frank opinions. The sample pair of pages illustrate the Armstrong technique


HOW DO YOU FEEL
like this
or —
like this
THE FIRST THING
SECURITY OF JOB AND INCOME
Your company tries to forecast the demand for its products. These forecasts are made to try to cut down this business of hiring a bunch of men and then laying them off. We want an even rate of employment. When a layoff cannot be avoided, the company always tries to give advance notice.
If a job is temporary, a man is told that fact beforehand.
Unemployment benefits were started two years ago. If a man has been with the company a year, he gets paid for four weeks after layoff, and an amount equal to 60 per cent of what he would have earned if he had been working. And if he has had more than a year's service, he receives unemployment benefits over a longer period. This plan also has a "make up" feature to help out during "short time." Salaried employees also are given due consideration when layoffs have to be put into effect.
4
.....Get your pencil ready
Read over the paragraphs on the opposite page. The company appreciates that the loss of a job is a very serious matter.
Do you agree that the company is doing its best to avoid layoffs? Please check. Yes ☐ No ☐
What can you suggest beyond what is now being done to help avoid them?
Do you think the unemployment benefit plan is okay? Yes ☐ No ☐
If you don't like the plan, what do you think is wrong?
Now turn to the next page.....
3

How Well Is Your Plant Run?

U. L. HARMON
Vice-President
Dryden Rubber Company, Chicago

6. Performance Standards

STATIC

In Company A, the static organization, there is no conception of the meaning or purpose of standards. The order comes to the factory, and the factory tries this or that, finally arriving at something that satisfies the customer. No attempt is made to record which "this" or "that" did the trick. Another order comes in, and the whole procedure is repeated.

Something goes wrong with factory processes. Without checking the history of the case to see where the error occurred, changes are made until the problem corrects itself. They go blissfully on from there.

Since Company A has no development department that functions as such, and since its laboratory is directly under the control of production, any so-called specifications in use at the moment may be changed to suit the production needs of the next month. Poor workmanship, slipshod gages, gravities, and pressures may necessitate these changes, but rather than put the factory in order to correct conditions, stock and methods changes are made which upset any attempt at control.

Since there are no standards whatever, costs as originally estimated are not correct for any considerable period of time after the product is started in production. Costs are not tied in with general accounting, hence do not reflect losses. Excess cost is never found until the sad picture is revealed at the end of the accounting period.

SEMI-PROGRESSIVE

One finds about the same situation in Company B, although some standards are incorporated in its procedures. These standards are not work rules, however, but rather a record of what was previously done.

As in the static organization that has just been examined, when changes are made in the factory, the laboratory, the development, and the time-study departments are notified afterwards.

Methods are worked out by the trial-and-error method in the production department. Then the time-study department tries to set up piecework rates by timing operations as they are being done without ever taking into consideration the vital question of whether they are being done with the least lost motion or in the right manner.

Since methods are often changed without notifying the time-study department, wrong rates are applied and employees fail to make their rates, or else their earnings far exceed what they should be.

Costs are used for establishing selling prices only, are not checked against actual performance.

Little provision is made for the control of burden. Expense, material, and indirect labor costs are often thrown into direct cost for the sake of convenience in figuring, since the only control attempted is an over-all material and labor cost rather than a breakdown aimed at the high spots.

MODERN

Since Company C is a modern organization, the observer expects to find, and does find, that standards are set up in the laboratory for control of raw materials. The purchasing department is given the required specifications, and materials are checked as received to make sure that they meet the specifications.

Company C's laboratory likewise establishes standards for the control of factory stocks, and through constant check of processed materials insures uniformity of product.

In the factory, the engineering department of this thoroughly modern organization establishes standards for production equipment and speeds for output. The time-study department establishes working speeds. And the production superintendent sees to it that these standards are adhered to.

Production reports, labor reports, and material consumption reports, together with a report of scrap and waste, indicate clearly whether or not standards are followed. Effort is concentrated on the items that are out of line.

So much for the physical handling of the plant. The accounting department establishes flexible budget standards, and burden or overhead expenses are controlled departmentally and sectionally.

Standard costs are used not only for estimating and establishing selling prices, but also as a tie-in with general accounting.

7. Standard Costs

STATIC

The use of standard costs means only that the cost of an individual product is estimated from previously arrived-at standards for materials, labor, and overhead. After the product becomes a production item, these estimates are checked against actual performance. If actual per-

SEMI-PROGRESSIVE

In Company B, as stated before, costs are figured for selling purposes and are purely historical. Should there be a general increase in material or labor costs, the costs are reviewed, not for interdepartmental changes, but for revision of selling prices.

MODERN

The standard cost system is used in Company C, our modern organization. That is to say, costs are set up for selling prices, and then when business is obtained actual manufacturing costs are closely followed to see that the original estimates have been met.

formance is higher than standard, the cause is immediately determined and corrected, or else the cost standard is changed.

At the end of the accounting period, production by units is tabulated and priced as to material, labor, and overhead at this standard cost. This cost is balanced against actual cost, which immediately tells whether or not the factory is doing a good job—and if not, where the bad job is being done.

Standard costs are unknown in Company A. Costs are used for estimating purposes only, and they are not tied in with general accounting. Piece production records are not kept as such, although the sales departments do keep these records for purposes all their own.

The general books are not closed monthly but on a quarterly basis after a physical inventory.

There is no possibility of estimating profit or loss for any shorter period. Anything might happen and no one would be the wiser until the books are closed. When that happens, profit and loss is not departmentalized, and it is impossible for management to tell where a profit or a loss occurred, or why.

Each department of office and factory maintains a multitude of records, statistics, and reports. Often two or more divisions build up somewhat similar reports, not knowing that others have the same information, since they do not tie in with any general program.

There is no knowledge of the effect of the individual profits or of order pricing on the total profits of the business.

The accounting division, and therefore the management, has no knowledge of actual cash outlay or its effect upon overhead costs at varying degrees of utilization of plant capacity. Since overhead costs are not broken down into fixed and controllable expense, any effort to control overhead is done by the rule-of-thumb method.

The worst feature of it all is that the management does not know which lines are profitable and which are not, which departments are well managed, whether the profit or loss occurs through errors in cost estimating and establishing the wrong selling prices, through improved or retarded factory operations, or because selling margins were or were not properly established.

Raw materials records and production records are maintained, and at the end of the accounting period these records are priced and checked against the actual costs. The accounting procedure is designed to exhibit standard performances and variances instead of being nothing but ancient history.

All unnecessary accounting and recording are eliminated, and whatever records are necessary are tied together for general analysis. All control records and reports are tied into standard costs under direction of the accounting division.

The effect of selling prices of individual products on the total profits of the business under varying levels of capacity utilization is known positively at all times by Company C's management.

Through these methods the determination of cash outlay costs by product and by overhead absorption at varying levels of capacity utilization can be found. The effect on cost and profit caused by additional volume is also easily determinable—a feature of the standard cost system that is extremely valuable to the management in dull seasons or in periods of depression.

8. Accounting Procedures

STATIC

Accounting is not highly regarded as a tool of management in Company A. Members of the organization have been told to keep no records and gather no information that is not needed to close the books.

The accounting procedure is old-fashioned and incomplete from a bookkeeping standpoint. Since no analysis is made of the statistics compiled, the system serves the company's purpose only so long as the figures stay in the black. The organization would be completely lost if the resulting figures should happen to be in the red.

SEMI-PROGRESSIVE

The accounting procedure in Company B, the semi-progressive organization whose management policies we are examining in this series of articles, is fairly comprehensive in its scope, undeniably accurate in the results it gets, certainly well enough managed.

The fundamental trouble with this concern's accounting practices lies solely in the fact that they go only so far and then stop short. Thus they miss perhaps the most important phase of their usefulness, in that they are not complete enough for management control.

MODERN

In Company C the accounting procedure is designed with a view of its total effectiveness. Procedure reports and records are all established for the purpose of closing the books as rapidly as possible at the end of the accounting period, and then form the basis for management's control of the various departments.

The accounting department is nonproductive in the sense that its efforts are not salable, but it points out the errors of the factory's way so that its products may not only be manufactured economically but also sold profitably.

9. Budgetary Control

STATIC

Company A frowns on any type of budgetary control. It has no broad-gage, long-term program. Its policies are vacillating and are not founded on thoughtful analysis or complete information.

In the sales department, cost estimates are ignored where considerable

SEMI-PROGRESSIVE

Divisional accounting reports in Company B periodically exhibit comparisons of current with past periods. There are no standards, hence it is impossible to compare actual results obtained with what should have been accomplished.

There is no centralized control of

MODERN

Standards of performance are found in all operating divisions of the modern organization, including purchasing, factory, maintenance, and sales. Weekly and monthly reports indicate actual costs compared with standards—not compared with what they were in a previous period,

volume is involved, especially in times of low sales. There is no conception of the effect on profits of cutting prices to meet competition. In other words, this static company lives from month to month, trusting altogether in the law of averages to keep it on the right side of the ledger—never the safe way.

selling prices within limits of predetermined profit requirements. No attempt is made to forecast sales, so no attempt is made to handle adequate supplies of materials. As a whole, there is something more nearly like control than in the static organization, but there is still much that might be hoped for.

but with what they should have been in the present period.

Sales quotas are established by territories, salesmen, and products, and are likewise compared with actual results. The management of Company C has a definite knowledge of the effect of all selling prices on amount of total profits.

10. Incentives

STATIC

Factory wages are for the most part paid on a straight daywork basis in Company A. Hours are long. Hourly rates are low.

There is a scattering of piecework on the larger production items, but rates are based on the management's conception of what an employee should earn, not on a study of jobs in relation to skill, energy, or length of time necessary.

Driving tactics are depended on for forcing production output.

There are no incentives either to the workmen or to the supervisory staff for superior effort or for traceable results. Output per person employed is low. Unit costs are high. Salaries of the staff are based on seniority or favoritism, usually the latter, regardless of the quality of the work produced or the responsibility of the position held.

SEMI-PROGRESSIVE

Piecework rates have been established in the semi-progressive concern, but they are the result of bargaining with labor rather than of accurate studies with due regard for production in excess of a fair standard. Earnings of employees are constantly under discussion.

The supervisory staff is not regarded for accomplishments traceable to their efforts, but rather for length of service. Less favoritism is shown than in Company A, but merit is not rewarded in any substantial way. Pay increases are usually granted on threats to leave or through outright bargaining.

Salesmen are compensated mainly for volume sold, regardless of territory, missionary work, etc. There is no basis for rewarding the profit value of salesmen's effort or of building up new sales territories.

MODERN

Here, in the modern Company C, both the staff and the factory supervisory force are compensated on a rated basis established on time production standards which not only increase labor's earnings but also decrease unit manufacturing costs.

There are no bottle necks, no backtracking, since all production operations are carefully charted and coordinated.

In this factory many of the so-called service occupations such as trucking, shipping, warehousing, sweeping, and janitor service are on a group bonus plan. Routine stenographic and filing work are on a similar incentive basis.

Salesmen's salaries are based mainly on volume, then on gross profit realization with extra compensation for missionary work in developing new territories or new lines.

11. Research

STATIC

Our examination into the management policies of these three mythical organizations closes with their respective attitudes towards research. In an old-fashioned outfit like Company A, it comes as no surprise to find that there is no research department or activity of any sort whatsoever. No further commentary on this concern's methods would appear to be necessary.

SEMI-PROGRESSIVE

There is some research effort in Company B, which is after all a moderately progressive concern. But what effort there is along these lines is spasmodic, to say the least. Research objectives are anything but definite. Methods fall far short of being truly scientific. And results are never better than might be expected from such a poorly planned and badly controlled effort.

MODERN

In Company C, the modern organization, it is not at all surprising, on the other hand, to learn that there is a well-planned program which aims at constant improvement of product, production equipment, and methods of manufacture. It is concerned not only with the development of new products and new markets, but also with the perfection of distribution methods.

With this installment, Mr. Harmon's three-part analysis of "industry as it is managed" comes to a close. In it he has taken three mythical organizations apart to see what makes them tick. The result is a yardstick of sorts which plant operating men, no matter what industry they are in, can use to evaluate their own concerns' management policies

The Variable Budget in Management by Exception

AUTHOR
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In Two Parts — Part One

The author was formerly with the General Electric Company, Schenectady, and the A. O. Smith Corporation of Milwaukee. Many of the exhibits shown throughout this section follow the plan used by the A. O. Smith Corporation. The flexible budget as used by the General Electric Company was described by Mr. Gardner in the February and March, 1934 issues

THIRTY-FIRST IN THE SERIES OF
FACTORY MANAGEMENT and MAINTENANCE
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I. Principles of the Variable Budget

TODAY our business technique presents many new aspects, and management demands that statistical information expressing trends be of a more dynamic nature. There is a very firm feeling that the monetary value of costing in manufacturing products is one involving an educational program that will carry costs to the man down the line who is responsible for the factors producing costs.

In the immediate future, cost reductions will come mainly from better control of burden. It is unreasonable to expect any great amount of cost reduction to come from material savings, because material represents labor for others. We shall be extremely fortunate if better material utilization is great enough to offset the expected increases in material prices.

It seems imperative that management should be furnished with expressions of value or relationship, which in themselves may not be dollars-and-cents costs, but which if controlled and regulated will produce satisfactory costs. A greater responsibility therefore devolves upon those who must produce information to present statistics that management can use easily and effectively.

Speak for Themselves

Of vital importance in the presentation of information to management is the method in which statistics are displayed. In preparing the exhibits attached to this article great attention was placed on simplicity and conciseness. The reports were designed to speak for themselves. Actually, they created a new type of enthusiasm in the management that received them.

An organization geared to a given volume of output can make a reasonable return on the invested capital if it can sell that output for a reasonable period of time. Any shop curtailment of volume alters the situation. The past six years have shown the influence of volume on profits and operating efficiencies.

Until 1929, we were content to measure profit relationships with static factors. Since that time we have attempted to measure the influence of volume. In the field of budgeting we have been able to meet the challenge by the Variable Budget. By its use, we are able to replace static forecasts with dynamic predictions.

Since a good share of the influences that affect the decisions of management today are in a state of flux, it is essential that management make full use of the simplest forms of expression both of results and expectancies. When management follows this procedure, a new ease and accuracy in execution are gained.

In our problem of making a return on our investment, we find that some of our costs are constant—that is, they do not vary with sales volume. For example, depreciation, some taxes, and certain operating costs go on day by day as long as we remain a going business, regardless of the volume of sales. Other costs vary with output. It is the primary function of a variable budget to point out these relationships. Once the relationship is established, we can measure our activities from minimum to maximum output by predetermining the *fixed* and *variable* factors. Further, we can do this for subdivision of output or lines of product as necessary for systematic management.

Effect of Constant and Variable Charges on Costs

The effect of constant and variable charges upon costs may be illustrated by the family automobile. Assume that it costs $30 per month for depreciation, obsolescence, insurance, garaging, etc., regardless of whether it is operated. Assume that the cost of gas, oil, tires, repairs, which varies directly with the mileage, amounts to two cents per mile. The cost per mile is therefore

$$\frac{(\text{Miles per month} \times 0.02) + \$30}{\text{Miles per month}}$$

or, if C equals cost per mile, and M equals miles per month,

$$C = \frac{0.02M + \$30}{M}$$

How number of miles operated (volume) affects cost per mile (unit) is quite simply illustrated in Table I on the facing page.

A study of this case shows several things of importance. First, whereas total cost increases as mileage increases, cost per mile decreases. Further, this decrease comes not in better operating efficiencies but in the fact that *fixed* costs decrease as mileage increases. Exactly the same principle applies to business.

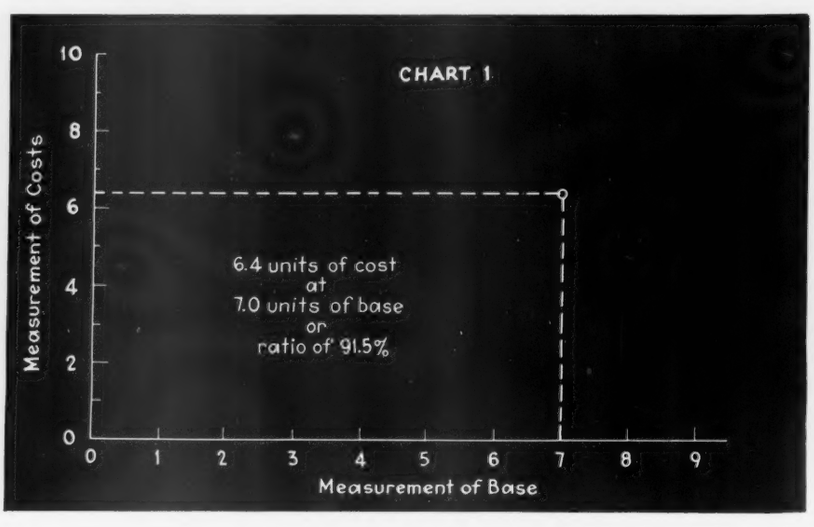
If costs were segregated in the same way between the *fixed* and *variable* elements, it would be relatively simple to determine cost under changing conditions. Just as you can figure the factors that affect automobile costs at any mileage almost at random, so can the average manufacturing cost be figured by the use of *variable costs*.

Basis for Measuring Variable Costs

In the illustration of the family automobile, the basis of measurement is the *mile*. Why? First, because it is the best known measure. Second, because it is a unit understood by everyone. Third, because it is readily obtainable.

Thus before any costs can be segregated, it is essential that some unit of measure be established. This unit is known as the *base*. Using the rules given in the paragraph above, this unit should be the *sales dollar* or an expression of the sales dollar. In most businesses we spend money to make money, and since sales are the expression of the income, then all cost involved in making the sales should be related to sales. Unfortunately, the problem is not always quite so simple as all that.

The sales dollar may not always be the best expression of the activities. Sometimes some factor such as productive labor in dollars or hours may better express volume output. This is usually true in a factory. The important thing to remember is that,



in establishing a base for simple operations, it should be one that is easily obtained, definitely understood, and readily converted into relative units of output. Once such a base for simple operations has been established, all other costs should be related to it.

In carrying out the idea of this presentation, I shall use a series of charts to express conditions. In these charts the base is measured across the bottom and the elements of expenditure that relate to the base are measured along the side. Therefore, any point within the limits of this chart represents a realization of costs to the base which can be expressed in many ways but definitely as a ratio of cents per dollar to the base. In Chart 1, for example, conditions are expressed as 6.4 units of cost at 7 units of base, or a ratio of 91½.

Fixed Costs

The most important element of cost, because it is the one that presents the greatest difficulties of control to management, is the *fixed* element. In all costs, and in all lines of business endeavor, there are certain fixed items such as depreciation, some taxes, some insurance, salaries of key supervisors, and even such expenses as watchmen's services and many others that are too numerous to mention but which are definitely fixed.

They are fixed in the sense that they have little or no relationship to the base or volume on which the business is built. It is extremely important that these items be recognized and expressed in such a way that they will constantly come to the attention of management when unusual conditions result.

Fixed costs are broken down into two general classifications. One, *standby fixed*; two, *executive decision fixed.* Standby fixed are the minimum costs that can be expected as a going concern ready and waiting to perform the services intended. The costs fixed by executive decision include the balance of the items that cannot be controlled to the base as such, but vary in their amount as management contracts and expands from time to time—something that all management does.

Under no circumstances should a cost fixed by executive decision contain any elements except the expansion and contraction of items included in the standby fixed. All other costs are *variable* and should be treated as such. One of the most delicate set-ups in establishing the flexible budget, and one that can be obtained only from experience in this work, is found in setting out correctly the cost fixed by executive decision so that it does not distort the variable elements of cost which must be controlled constantly by all the people in the organization who spend money for one thing or another.

The importance of the fixed element is indicated in Chart 2. Notice the influence in the cost dollar in various levels of activity. At three units of output, *A*, the fixed elements of cost amounts to 50¢ of every dollar of base, whereas at eight units of base, *B*, it is only 18.75¢. Profits or losses swing with this relationship. That, of course, is why it is of such unusual importance to management.

The illustration of the family automobile affords tangible evidence of the importance of this item. While the fixed cost is $30 at all mileages, it is equivalent to $0.30 per mile if we operate only 100 miles during the month, but when we operate 3,000 miles it is only $0.01 per mile.

Variable Costs

After we have established our fixed items of cost, our *variable costs* become the difference between the total cost and the fixed cost. This is true only if it is recognized that the total costs are correct. To insure that the total costs are correct, it is essential that the variable costs be analyzed in enough detail to support current-day expenditures so that management can feel confident of the reasonableness of

TABLE I. How Number of Miles Operated Affects Cost Per Mile

Miles per Month	*Fixed Cost*	*Variable Cost*	*Total Cost*	*Av. Cost per Mile*
100.....	$30	$2	$32	$0.32
500.....	30	10	40	0.08
1,000.....	30	20	50	0.05
3,000.....	30	60	90	0.03

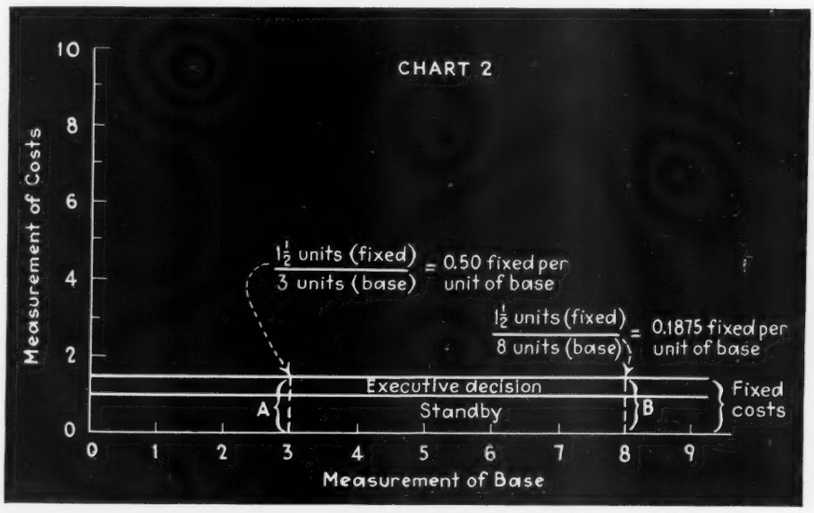
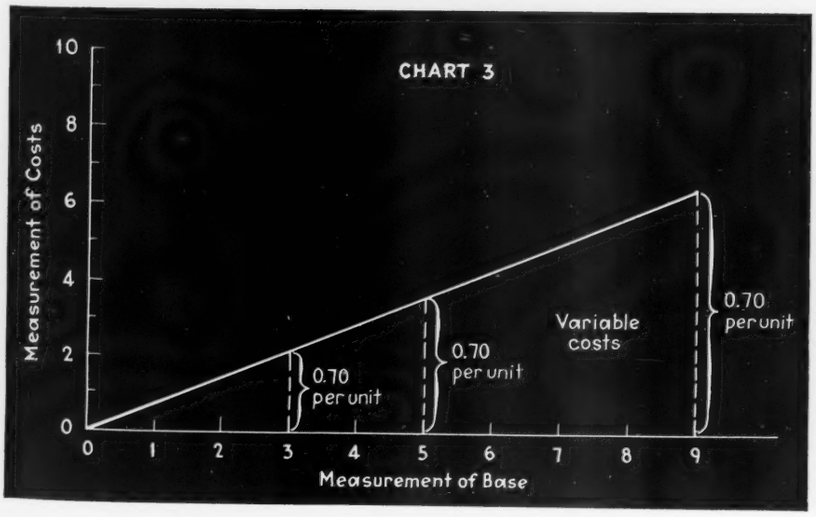


CHART 2
Measurement of Costs
1½ units (fixed) / 3 units (base) = 0.50 fixed per unit of base
1½ units (fixed) / 8 units (base) = 0.1875 fixed per unit of base
Executive decision
Standby
A
B
Fixed costs
Measurement of Base



the costs and can actually use the variable factors to control day-by-day operations.

Chart 3 shows an expression of variable costs. The current costs amount to 70¢ per unit of base. To illustrate, if our base was the sales dollar, this 70¢ per unit is reasonably accurate as a variable current multiplier of this sales dollar.

It has been my experience that the establishment of such a factor, even though at first it is in no more detail than the 70¢ expressed above, is very helpful to management because it establishes a new line of thought. Of course, the further this factor is segregated (provided it is not overdone by too much detail), the more useful it becomes to more individuals in the organization.

It is not my intention to leave you with the impression that one over-all flexible cost per dollar of base necessarily holds at all levels of activity. Many times this is not the case, and only by individual application can this problem be settled. There is, however, this point: Experience has indicated that in most normal and efficiently operated enterprises one total factor of variable costs to base is usually satisfactory for normal operating conditions between 40 and 100 per cent capacity.

Putting the Factors Together

Once the elements of nxed and variable costs are established, costs in an organization become an expression of so many units of variable to the base plus so many units of fixed for a given period of time. See Chart 4. With these factors, management can bridge the gap, almost at will, in the discussion of volume and the regulation to costs and to the profits accruing therefrom. To illustrate, suppose we are in the business of producing a product which sells for $1 per unit. Our normal volume is 80,000 units per month. Expressed in sales, this is equivalent to $80,000.

Let us assume further that our variable cost per dollar of sales is 70¢ per unit and that our *fixed* costs are $15,000 per month. First, can we make money on this volume? Let's see: 80,000 times 70¢ equals $56,000 variable costs, plus $15,000 *fixed*, or $71,000 total costs, which leaves $9,000 profit. These calculations can be made almost as fast as a conversation concerning the factors is developed.

Now let us carry this one step further. Assume that during a sales meeting the possibility is discussed of the volume falling to 50,000 units per month. Are we faced with many problems? Let's see: 50,000 times 70¢ is $35,000 variable expense, plus $15,000 fixed, equals $50,000. Selling price $50,000, profit nothing. We can therefore exist on that volume if we can keep our variable expenses in constant control day by day.

These factors are so simple that they could be worked out during a meeting, and many possibilities could be considered by the use of these elements in putting into tangible values various expressions of opinions or expectancy. This method of calculation can be carried on indefinitely. The main point of emphasis here is the fact that by the use of variable costs, management can make intelligent, quick, and comprehensive decisions almost as fast as the various factors are brought out.

Chart 5 expresses this over-all problem, for here are shown not only the fixed and variable elements of cost but also the profits that result from these elements and from the sales values in use. It expresses the points at which the business is profitable and unprofitable, and shows the relationship of the variable and fixed elements in costs in any losses that are sustained.

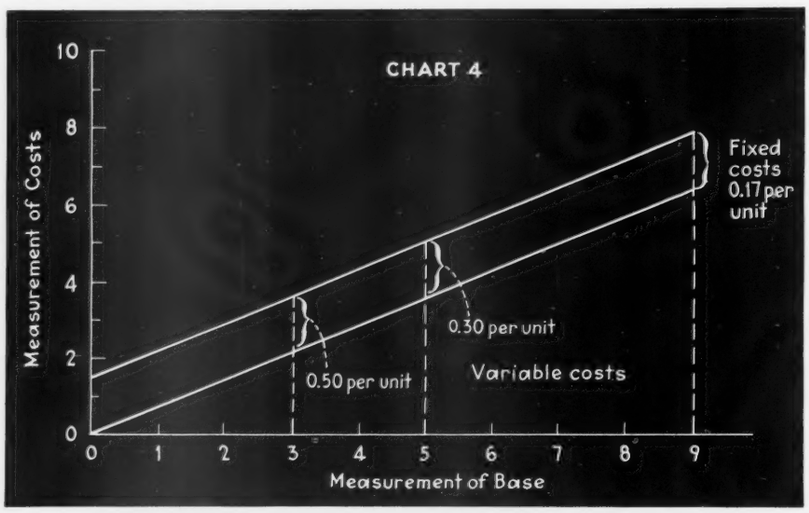
It is my belief that this chart, even when expressed in the simplest of generalities, provides a new key to the problem of cost analysis, cost control, and the profits accruing therefrom.

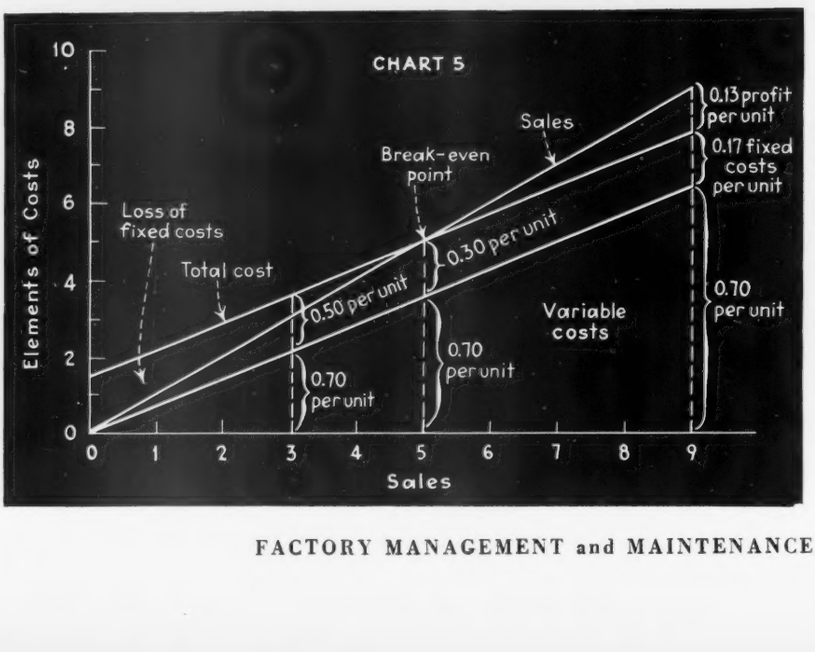
Conclusions

If you want a simple, concise measure between the elements of costs and their relationship to sales and to the profits which accrue, I suggest that you turn to the variable method of costs and cost analysis, so that you can develop factors that are as quantitative to you as pounds, feet, and years are to the average person.

Today management is running a race against changes so comprehensive that we are not as yet sure of the ultimate consequences. To keep up requires the development of benchmarks to use as we run—benchmarks that are simple, yet accurate enough to provide a sense of security in the results.

If we face the facts, we shall find that the use of variable budgets answers many of our questions. If, however, we expect that the principles laid down here are new management we shall be deceived because variable budgets provide only a needed tool for *progressive* management. There is no substitute for management, but even good management wants help.





II. The Control of Manufacturing Expense or Burden

MOST heads of organizations are alike in one respect. They are constantly harassed and disturbed by the mass of details that they must pick apart to procure the meat of everyday happenings. The wide-awake manager today hungers for more vivid information and less detail.

Faced with this problem in a company employing 6,000 men, with a highly seasonable, diversified product, we turned to the variable budget to control expenses, and through development of this control have reduced to a minimum the details that the head of the organization must peruse to follow burden costs.

All on One Page

By constant review of the information contained in Exhibit I, the head of this large, diversified organization has on one page *all* the information necessary to give him a recapped control of all the functional supervisors reporting directly to him.

Not only is the current expenditure of $152,742 as shown on this report expressed to him in terms of functional responsibility, but it is also compared with the approved and predetermined budget allowances.

Beyond the importance of this comparison is the virtue of getting the information quickly, usually on the third working day and not later than the fourth. To strengthen this report and to make it of the greatest value for costing purposes, there have been added to it "benchmarks" for previous months which give the report positive relationships. (Notice section marked 9). These percentages can be compared with the average so far this year, the previous month, and with the current month.

If the head of the organization is satisfied with the results as expressed by this weekly report, no further detail is necessary. If, however, he finds reason to question any of the figures shown, the resulting review that he makes is one of working *toward* the details rather than *through* them.

In other exhibits we shall follow individually the procedure to support his reactions resulting from unsatisfactory expressions of results. For illustration I have singled out the vice-president in charge of manufacturing (Item 1) and the vice-president in charge of sales (Item 2).

Exhibit II is a comparable report prepared for the vice-president in charge of manufacturing. The total of this report (Item 1) is the same amount shown at 1 in Exhibit I, i.e., $116,285.

Only Three Days Old

Following item 2 on Exhibit I to Exhibit III, we find the detailed control which supports the activities of the Sales Manager of lines 3 and 4. Notice that this information is prepared within three days after the end of the period and that the figure of total expenditures for all the districts ($8,196) is the same as in Exhibit I, Item 2.

On this report also appear sales quotas. For the current month the sales manager has exceeded his quota and has a realization of 169 per cent. Since his expense allowance is based on the principle of the fixed and variable budget, he is expected to meet his budget currently regardless of realization of quota, because additional expense is allowed when he exceeds his quota.

A study of the information included in the section marked 9 provides both the president and the sales manager with significant information showing cost trends from month to month which are readily related to current results. Notice the extreme variation in the realization of the sales quota from month to month in this particular line and also the cost of sales that results from these wide fluctuations. A report of this type should furnish enough controversial information to keep the president and sales manager busy for some time to come.

Breaking It Down

To complete the sales analysis, it is necessary to break down Exhibit III by districts. For the sake of illustration I have selected District 4 (Exhibit IV). Step by step we are proceeding toward the basic details supporting actual expenditures, and the total expense of District 4 of $1,501 can be found included within the total expense of the Sales Manager's Report, Exhibit III. This report is furnished to the district manager weekly on the same day his superiors receive their reports.

There is an interesting sidelight concerning the problem we are discussing. In the past we have found it

EXHIBIT I

BUDGET REPORT

FOR PERIOD ENDING August 4, 1937

SUPERVISOR President or Head of Organization DATE ISSUED August 10, 1937

DEPT. OR ACC'T NO.	NAME OF DEPT	ACTUAL EXPENSE	BUDGET ALLOWANCE	GAIN OR LOSS OVER BUDGET	% OF REALIZATION THIS PERIOD	% OF REALIZATION LAST MONTH
	Vice Pres. in Charge of Mfg	116 285	88 573	27 712*	76	71
	Vice Pres. Sales Line 1&2	1 022	550	472*	54	50
	Asst. to Vice Pres. Sls. Line 1&2	902	778	124*	86	81
	Vice. Pres. Sales Line 3&4	8 196	7 818	378*	95	92
	Research and Engineering	(2 635)				
	Research and Engineering	4 237)	6 960	88	101	105
	Patent	206	522	316	253	117
	General	27 909	27 805	104*	100	98
	Financial	652	247	405*	38	37
	Less Depreciation in Factory rental duplicated in Vice President in Chg. of Manufacturing Functional Budget	3 891*	3 891*			
	Adjustment to Balance*	5 411*		5 411		
*	Credits, Deductions or Over Budget					
TOTAL	of all expenses under Supervisor's control	152 742	129 362	23 380*	85	74

	ACTUAL EXPENSE	GAIN OR LOSS OVER BUDGET	% REALIZATION	DOLLARS OF ACTUAL EXPENSE TO PRODUCTION BASIS: PLANT PROD LAB	STD COST DOLLAR	SALES DOLLAR
JAN.	871 077	364 919*	58	7.08	0.755	0.667
FEB	972 798	370 405*	62	5.41	0.557	0.492
MAR	1 108 197	397 355*	64	4.71	0.464	0.406
APR	1 105 622	384 481*	65	4.36	0.463	0.401
MAY	1 195 918	400 865*	66	4.18	0.438	0.375
JUNE	942 187	269 376*	71	5.20	0.516	0.434
JULY	803 466	212 245*	74	4.15	0.455	0.382 (X)
AUG.	152 742	23 380*	85	3.34	0.538	0.294 (1)
SEPT.						
OCT						
NOV						
DEC.						
AVE TO DATE	999 895	342 806*	66	4.80	0.500	0.430

*ONE MILL ($0.001) REDUCTION IN RATES OF EXPENSES TO SALES EQUALS $25,000 PROFIT PER YEAR

Sales Dollars
0.623
0.475
0.476
0.390
0.436
0.537
0.408

*Vice President Sales Line 3&4 Functional is through August 6, 1937
(X) Preliminary
(1) Through August 4

EXHIBIT II

BUDGET REPORT

FOR PERIOD ENDING August 4, 1937

SUPERVISOR Vice-Pres. in Chg. of Mfg. DATE ISSUED August 11, 1937

DEPT OR ACC'T NO	NAME OF DEPT	ACTUAL EXPENSE	BUDGET ALLOWANCE	GAIN OR LOSS OVER BUDGET	% OF REALIZATION THIS PERIOD	% OF REALIZATION LAST MONTH
Division	Plant #1	46 649	23 518	23 111*	51	47
	Plant #2	27 390	23 431	3 959*	86	72
	Plant #3 and #4	22 156	20 382	1 774*	98	73
	Misc. Productive	834	819	15*	98	73
Functional	Maintenance	10 944	11 463	319	105	85
	Inspection	3 043	3 078	35	101	92
	Cost Department	5 389	5 702	313	105	97
	Industrial Relations	2 118	2 300	182	109	92
	Timestudy & Standards	1 114	1 230	116	110	84
	Tools	6 983	6 023	960*	86	84
	Production and Shipping	8 539	7 625	914*	89	78
	Production Engineering	990	1 095	105	111	86
	Machine Design	1 002	925	77*	92	80
	Laboratories	708	604	104*	85	85
	Other Miscellaneous Depts.	2 039	2 450	411	120	97
	Production and Engineer.	990	1 095	105	111	86
*	Credits, Deductions or Over Budget					
TOTAL	of all expenses under Supervisor's control	116 285	88 573¢	27 712¢*	76	71

	ACTUAL EXPENSE	GAIN OR LOSS OVER BUDGET	% REALIZATION	DOLLARS OF ACTUAL EXPENSE TO PRODUCTION BASIS: PLANT PROD LAB	STD COST DOLLAR	SALES DOLLAR
JAN	572 247	329 396*	42	5.29	0.649	0.603
FEB	389 865	323 050*	52	3.83	0.394	0.348
MAR	343 488	349 350*	57	3.58	0.353	0.308
APR	345 260	341 465*	58	3.22	0.356	0.307
MAY	317 657	354 780*	61	3.22	0.338	0.288
JUNE	565 396	236 418*	64	3.67	0.365	0.306
JULY	545 125	156 557*	71	2.82	0.309	0.260
AUG.	116 285	27 712*	76	2.54	0.272	0.224
SEPT.						
OCT						
NOV						
DEC						
AVE. TO DATE	728 434	298 694*	59	3.49	0.364	0.313

ONE MILL ($0.001) REDUCTION IN RATES OF EXPENSES TO SALES EQUALS $25 000 PROFIT PER YEAR

(X) Preliminary
(1) Month to Date
¢ Does not include duplication of accounts in functional groups

EXHIBIT III

BUDGET REPORT

FOR PERIOD ENDING August 1 thru 7,1937

SUPERVISOR Vice Pres. in Charge Sales Line 3&4 DATE ISSUED August 10, 1937

DEPT. OR ACC'T NO	NAME OF DEPT	ACTUAL EXPENSE	BUDGET ALLOWANCE	GAIN OR LOSS OVER BUDGET	% OF REALIZATION
	Local (Actual)	3 389	2 989		88
	Less Local Dist. to Div.	3 389*	2 989 *		
	Dis. 1	860	619	241*	72
	2	709	481	228*	68
	3	1 647	1 611	36*	98
	4	1 501	1 575	74	105
	5	1 697	1 242	455*	73
	6	1 706	2 125	419	125
	Advertising	76	165	89	127
	Memo: August 1 thru 7				
	Actual - $477 614				
	Quota - 222 917				
	R% - 169%				
*	Credits, Deductions or Over Budget				
TOTAL	of all expenses under Supervisor's control	8 196	7 818	378*	95

PERIOD	SALES DOLLARS: ACTUAL	QUOTA OR BUDGET	% REALIZATION	EXPENSE DOLLARS: ACTUAL	BUDGET	GAIN OR LOSS	% REALIZATION	COST PER $ SALES: OWN SALES	COMPANY SALES
JAN.	530 840	891 667	60	18 567	16 567	2 369*	87	.0356	.0135
FEB	1 021 283	"	110	19 361	18 999	362*	98	.0189	.0095
MAR	532 292	"	60	25 348	16 695	8 563*	66	.0476	.0109
APR.	426 856	"	48	24 745	16 046	8 699*	65	.0580	.0087
MAY	406 896	"	46	23 030	15 836	7 194*	69	.0565	.0084
JUNE	291 808	"	33	22 602	14 817	7 785*	66	.0775	.0114
JULY									
AUG.									
SEPT									
OCT									
NOV									
DEC									
AVE TO DATE	537 258	891 667	60	22 348	16 439	5 909*	74	.0478	.0107

extremely difficult to collect reports on selling expenses, especially traveling expenses. Oftentimes there would be as much as six or eight weeks lag in these reports. Since such a practice would destroy the efficiency of this type of presentation, we found it necessary to overcome this handicap.

We hit upon the idea of having the district offices send to us each Friday on the teletype their expenses for the week through the preceding day. There was no great cost to this procedure because they had the teletype and used it daily.

Since undertaking this method at the first of the year there have been fewer than ten failures, all of which have been dealt with immediately. The results of this procedure have been twofold: First, up-to-date information; second, a feeling on the part of the district organization that there must be unusual interest in expenses in the home office because of the method being followed.

Easy to Follow Result

In most manufacturing organizations, burden is the most important element of cost. In the organization under consideration this item of expenditure is unusually important because it covers about 45 per cent of the total current activities and expenditures. The vice-president in charge of manufacturing, like the head of the organization, has always found it hard to follow results because of the mass of detail involved.

By the use of the recapped report, Exhibit II, he is able to gain a new approach to his problem because he has on his own report (also Exhibit II) the functional line control in detail supporting the total expenses that are shown on the president's sheet, namely $116,285. Further he has available, for certification as to results, enough detail supporting these items to make it possible to answer random questions arising in his mind or in the mind of his superior.

Control by Lines

One of the innovations on Exhibit II is found in the breakdown, which is of two types: Line Control Plant 1, Plant 2, etc., and Functional Control maintenance, inspection, cost department, etc. We have found that the final control must be to lines of products, that the final analysis of costs must be expressed in such terms, and yet the intimate and current control must be by the functional individuals who shape the general policies.

By this we mean that the heads of well-organized departments such as wage rate, machine design, laboratory, industrial relations, etc., which are daily playing a part in the policies that result in costs, should be controlled independently. The only control that will insure a measure of over-all balance

between these functions, however, is one showing their balanced relationship under the goal set for them by lines of products.

In order to show the mechanics of this report, let us go through the budget report with the vice-president in charge of manufacturing. He receives his report before noon on August 11. It covers all expenditures through August 4. Usually he looks at each subdivision and compares the realization of this period against that of last month. It is not uncommon for him to set the current report alongside the comparable report for last week so that he can compare at one glance the operating efficiencies by responsibilities—this week, last week, and last month.

In order to prepare himself for the onslaughts of the head of the organization, he is also comparing his total results as measured by his realizations (Exhibit II, Item 1). For example, this shows that his realization for this period is 76 per cent. This compares with a realization (which is detailed) for last month of 71 per cent. In the figures earmarked as Item 9 he can find the realization for prior months. For example, in January his realization was only 42 per cent, while in June it was 64 per cent and the average for the year to date is 59 per cent.

Improvement by the Month

The budgets were set after consideration of all concerned on a basis of what *each section should be able to do with the equipment and organization available.* While the realization is not satisfactory, improvements have been made month after month. It is hoped by the end of the year that the realization will be at least 90 per cent. Most of this saving has accrued from the pressure instituted by these reports and by the clean-cut method they have produced, allowing for quick revision of bad conditions.

Let me now call to your attention the series of ratios which the report contains (Item 9, Exhibit I). By months there are shown the ratio of expenses to the productive labor dollar, to the standard cost dollar, and to the sales dollar. All these ratios are shown on a production basis which eliminates the problems involved in the difference of production and sales, usually reflecting in finished inventory. Since the manufacturing organization is primarily interested in the problem of producing so far as burden is concerned, the control should necessarily be on a production basis.

For purposes of comparison, and in order to point out the strides made by the manufacturing organization, let us compare (see Table II) some of the figures shown in Item 9, Exhibit II.

Between January and July the expenses based on the same budget (the only changes being the results of the load variable) have been reduced from

EXHIBIT IV

BUDGET REPORT

FOR PERIOD ENDING August 1 thru 7, 1937

SUPERVISOR Head of District Sales #4 DATE ISSUED August 10, 1937

DEPT. OR ACC'T NO.	NAME OF DEPT.	ACTUAL EXPENSE	BUDGET ALLOWANCE	GAIN OR LOSS OVER BUDGET	% OF REALIZATION
	Salaries	288	482	194	167
	Rent	34	58	24	170
	Tel. & Tel.	-	43	43	-
	Entertainment	126	43	83*	34
	Travel	4	43	39	1080
	Auto	10	22	12	220
	Post. & Off. Supplies	10	7	3*	70
	Miscellaneous	29	10	19*	35
	Sub Total	501	708	207	141
	Milwaukee Burden	1 000	867	133*	90
	Memo. August 1 thru 7 - Sales Actual - 82,791 Quota - 34,375 R% - 241%				
*	Credits, Deductions or Over Budget				
TOTAL	of all expenses under Supervisor's control	3 → 1 501	1 575	74	105%

PERIOD	SALES DOLLARS ACTUAL	SALES DOLLARS QUOTA OR BUDGET	SALES DOLLARS % REALIZATION	EXPENSE DOLLARS ACTUAL	EXPENSE DOLLARS BUDGET	EXPENSE DOLLARS GAIN OR LOSS	EXPENSE DOLLARS % REALIZATION	COST PER $ SALES OWN SALES	COST PER $ SALES COMPANY SALES	
JAN.	191 156	137 500	139	3 382	3 793	411	110	.0177	.00242	.00638
FEB	58 349	"	42	3 331	2 541	790*	76	.0571	.00163	.00326
MAR.	40 064	"	29	4 437	2 325	2 112*	53	.1105	.00190	.00835
APR.	88 746	"	64	4 347	2 901	1 446*	67	.0489	.00153	.01015
MAY	103 914	"	76	3 862	3 079	783*	80	.0372	.00141	.00950
JUNE	89 006	"	65	3 951	2 747	1 204*	70	.0444	.00224	.00716
JULY	96 743	"	70	3 929	2 992	937*	76	.0406	.00199	.01348
AUG.										
SEPT.										
OCT										
NOV.										
DEC.										
AVE. TO DATE	95 425	137 500	69	3 891	2 911	980*	75	.0509	.00187	.00832

9

EXHIBIT V

BUDGET REPORT

FOR PERIOD ENDING August 4, 1937

SUPERVISOR Divisional Manager DATE ISSUED August 11, 1937

DEPT. OR ACC'T NO.	NAME OF DEPT.	ACTUAL EXPENSE	BUDGET ALLOWANCE	GAIN OR LOSS OVER BUDGET	% OF REALIZATION THIS PERIOD	% OF REALIZATION LAST MONTH
	Plant #4	9 353	8 465	888*	91	94
D.581	Plant #3 & #4 Engineering	178	155	23*	87	75
	Plant #3	8 385 → 5	7 764	621*	92	93
D.304	Plant #3 & #4 Administrative	284	299	15	105	106
D.103	Rivets	361	408	47	113	-
D.104	Waldrods	689	385	304*	56	-
	Sub Total	19 250	17 476	1 774*	91	90
S-199	Rental	2 906	2 906		100	100
*	Credits, Deductions or Over Budget					
TOTAL	of all expenses under Supervisor's control	4 → 22 156	20 382	1 774*	92	91

	ACTUAL EXPENSE	GAIN OR LOSS OVER BUDGET	% REALIZATION	DOLLARS OF ACTUAL EXPENSE TO PRODUCTION BASIS: PLANT PROD. LAB.	STD. COST DOLLAR	SALES DOLLAR	
JAN.	219 765	106 526*	52	1.713	.1900	.1682	
FEB.	214 319	60 287*	72	1.193	.1230	.1083	
MAR.	200 340	43 708*	78	0.845	.0835	.0729	(X) Preliminary
APR.	158 716	25 050*	85	0.625	.0665	.0575	(1) Month To Date
MAY	162 178	26 336*	84	0.569	.0597	.0510	
JUNE	158 982	17 595*	89	0.876	.0870	.0731	
JULY	128 013	11 254*	91	0.662	.0726	.0610	(X)
AUG.	22 156	1 774*	92	0.425	.0455	.0374	(1)
SEPT.							
OCT							
NOV.							
DEC.							
AVE. TO DATE	177 473	41 357*	77	0.851	.0887	.0765	

ONE MILL (.$0.001) REDUCTION IN RATES OF EXPENSES TO SALES EQUALS $20,000 PROFIT PER YEAR

9

TABLE II
Comparison of Results

Month	*January*	*April*	*July*
Actual Expense	$572.247	$845.260	$545.125
Gain or Loss over Budget	329.396	341.465	156.557
Realization 42%	58%	71%	
DOLLARS OF ACTUAL EXPENSE TO PRODUCTION BASIS			
Plant Productive Labor ...	$5.29	$3.22	$2.82
Standard Cost Dollar ..	0.649	0.356	0.309
Sales Dollar	0.603	0.309	0.260

$5.29 to $2.82 per dollar of productive labor. Consequently the cost per sales dollar for burden has been reduced from 60¢ to 26¢, which is the difference between success and failure over a sustained period of time.

Let us assume that the Vice-President in Charge of Manufacturing does not like the looks of the results shown by Plants 3 and 4. Through Exhibit V we are able to follow the details which show the breakdown between the plants and the several operating units. This can be carried on to Exhibit VI, where it is further possible to segregate by the overall results in each department in the plant under consideration.

Departmental Analyses

Supporting each one of these departments is a departmental analysis of expense which is prepared daily (weekly should be often enough). This report is given to the foreman and shows his expenditures by accounts between material and labor and the budget for each item. This information is presented here in Exhibit VII. If you will follow the figures in these exhibits you can readily check the figures which tie in one report with the previous report.

A thorough study of Exhibits I to VII inclusive will lead to the following conclusions:

1. A complete control of burden is available.

2. This control is *intimate* enough to command respect, *compact* enough to insure interest, and *flexible* enough to allow constant revision to keep pace with changing conditions.

3. Management can look *toward* the details and is never required to *build up from the details* to answer questions which the various reports stimulate.

4. By using the variable budget as a principle this method of presentation can be adjusted to meet the individual requirements of any organization, as well as keep pace with current volume changes.

(*Part Two is scheduled for publication in an early issue.*—Ed.)

EXHIBIT VI

BUDGET REPORT

Division Manager — FOR PERIOD ENDING August 4, 1937

SUPERVISOR Division Superintendent — DATE ISSUED August 9, 1937

DEPT. OR ACCT NO	NAME OF DEPT.	ACTUAL EXPENSE	BUDGET ALLOWANCE	GAIN OR LOSS OVER BUDGET	% REALIZATION THIS PERIOD	% REALIZATION LAST MONTH
134	Coupling Dept.	1 472	1 296		88	76
158	Field Division	-	-		-	56
190	Pickling - Plant #3	117	168		144	108
191	Scarf - Close and Weld Lugs	516	584		114	95
192	Weld and Flash Trim	1 855	1 645		89	95
193	Pipe Finishing	(2 560)	2 306		90	104
194	Pipe Threading	1 198	909		76	69
284	Coupling Storage	14	9		68	93
306	General - Plant #3	2 077	2 142		103	97
602	Tool Room - Plant #3	115	185		160	141
611	Maintenance - Plant #3	17	63		359	161
613	Cranes - Plant #3	59	88		148	148
665	Inspection - Plant #3	69	46		68	82
686	Pipe Storage - Plant #3	142	148		104	94
	Sub Total	10 218	9 597		94	93
	Rental Included above	1 833	1 833		100	100
	Total Less Rental	(8 385)	7 764		92	93
*	Credits, Deductions, or Over Budget					
TOTAL	of all expenses under Supervisor's control	10 218	9 597		94	93

	ACTUAL EXPENSE	GAIN OR LOSS OVER BUDGET	% REALIZATION	DOLLARS OF ACTUAL EXPENSE TO OWN PRODUCTION BASIS: OWN PROD LAB	STD COST DOLLAR	SALES * DOLLAR
JAN.	152 196	82 346*	46	8.25	0.422	0.346
FEB.	147 090	48 337*	67	6.20	0.284	0.236
MAR.	117 596	25 437*	78	5.52	0.214	0.178
APR.	84 107	12 434*	85	6.36	0.307	0.238
MAY	84 391	12 901*	84	6.42	0.278	0.220
JUNE	81 345	7 903*	90	5.94	0.454	0.320
JULY						
AUG.						
SEPT.						
OCT						
NOV						
DEC						
AVE TO DATE	111 121	31 559*	72	6.45	0.306	0.246

Productive Labor $ 1 817

% Expense to P. L. 522

REMARKS

S-1	5	55
S-18	456	429
S-39	207	80
S-45	28	28
S-77	-	-
S-64	37	-
Excess	215	-

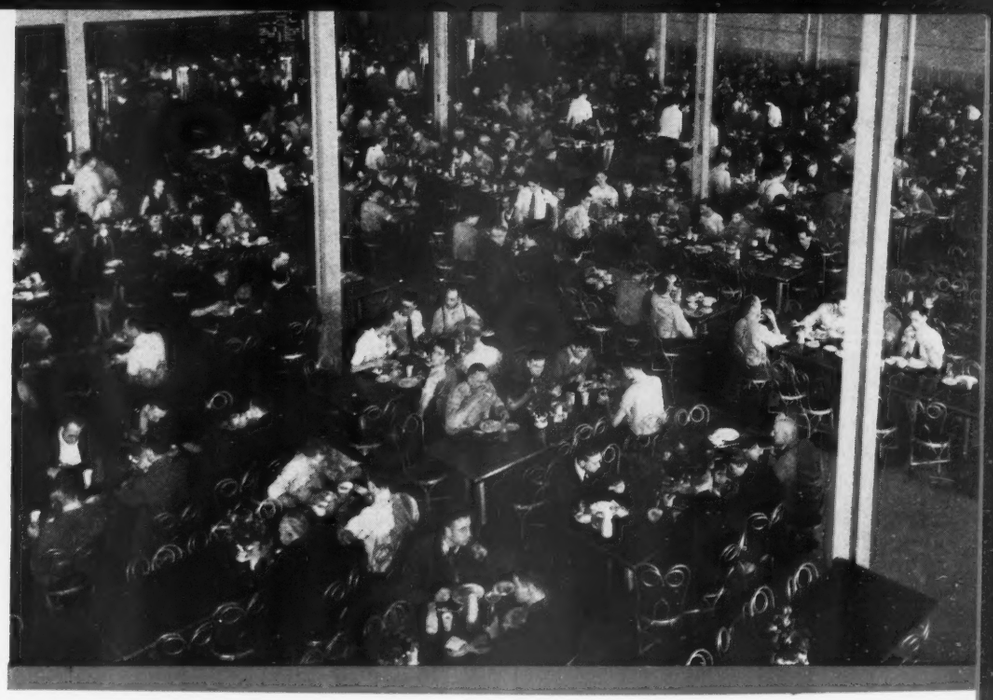
EXHIBIT VII

Date

ACCUMULATIVE BUDGET

Department 193 Basis 706.18

Acct.No.	Material	Labor	Total	Budget	Variance
1			.48	40.25	3976
7		68	68.06	46.10	2196
8		8	8.12	14.12	600
9		17	17.60	105.33	8773
12		2	2.80	9.18	638
18		165	165.82	237.52	7170
21				7.06	706
22		12	12.20	24.72	1252
23	47	7	55.31	54.58	73¢
27			.58	1.41	83
28	50	113	163.42	274.81	11139
29	3	7	11.27	10.95	568
30	2	7	10.30	10.59	29
31				6.36	636
32		4	4.02	1.41	261¢
34		71	71.68	104.39	3271
36		24	24.31		2431¢
37		12	12.00	12.98	98
39		17	17.85	23.30	545
40		5	5.88	5.88	
42		24	24.08	28.95	487
43	438		438.24		43824¢
46		4	4.00	4.72	72
47		5	5.20	7.06	186
53	146		146.67	105.24	4143¢
54			.58	21.89	2131
55	9		9.16	4.24	492¢
57		1	1.35		135¢
64		16	16.93		1693¢
65		17	17.67	56.24	3857
66	237		237.33		23733¢
72	52		52.92		5292¢
75	153		153.95		15395¢
94	6	160	166.82	144.77	2205¢
134			.88	1.41	53
199	492		492.00		48200¢
200		12	12.45		1245¢
201		128	128.98		12898¢
			2560.91	1371.46	118945¢
43				438.24	43824
199				492.00	49200
666				4.94	494
			2560.91	2306.64	25427¢



2,750 Meals a Day —and in the Black

Secret's in the kitchen. It's run like any production department. Has new, modern equipment. Is mechanized where possible

F. G. BARR
Supervisor, Industrial Relations Division
National Cash Register Company
Dayton

A RATHER FREQUENT question put to us is: "What is the value of your restaurant operations in your scheme of employee relations? Just what is the reason for going into it on so large a scale?"

To answer this simple inquiry would require a long explanation of our entire program of industrial relations. Reduced to barest outlines, our philosophy is that the relationship most satisfactory to employees and employer can best be cultivated under conditions that are genuinely pleasant and stimulating. As employers, our contribution to this set of conditions comes in the form of providing for the employees every comfort and facility we can afford.

Our restaurant operations are integral with this policy. The employee who has a good luncheon of the kind he enjoys at the price he can afford is a better employee—and it makes no difference in principle whether he works in the general office or in the foundry—or in one of the big corner private offices. The type of luncheon he requires, the surroundings he finds pleasant, the price he considers right—all these vary with the work and with the individual. Therefore, we operate an assortment of food services to meet varying specifications.

Both as a matter of principle and as a consideration of good business management, we do not run these food services at a loss. At one time we lost money on our restaurants, and considered that we were being kind-hearted employers thereby. With a change in restaurant management, however, the red ink changed to black, meals improved in quality, employees were better satisfied, and we were again shown that good management does not involve losing money steadily.

Nine Food Services

By our own tabulation, we operate nine different food services. One of these, the executives' dining room, is on an upper floor of our main office building and runs from its own individual kitchen; it can therefore be eliminated from further consideration in this article. We shall, however, deal with the other eight food services because they center on our new restaurant building, and all food served by them, except bread, is prepared in its kitchen.

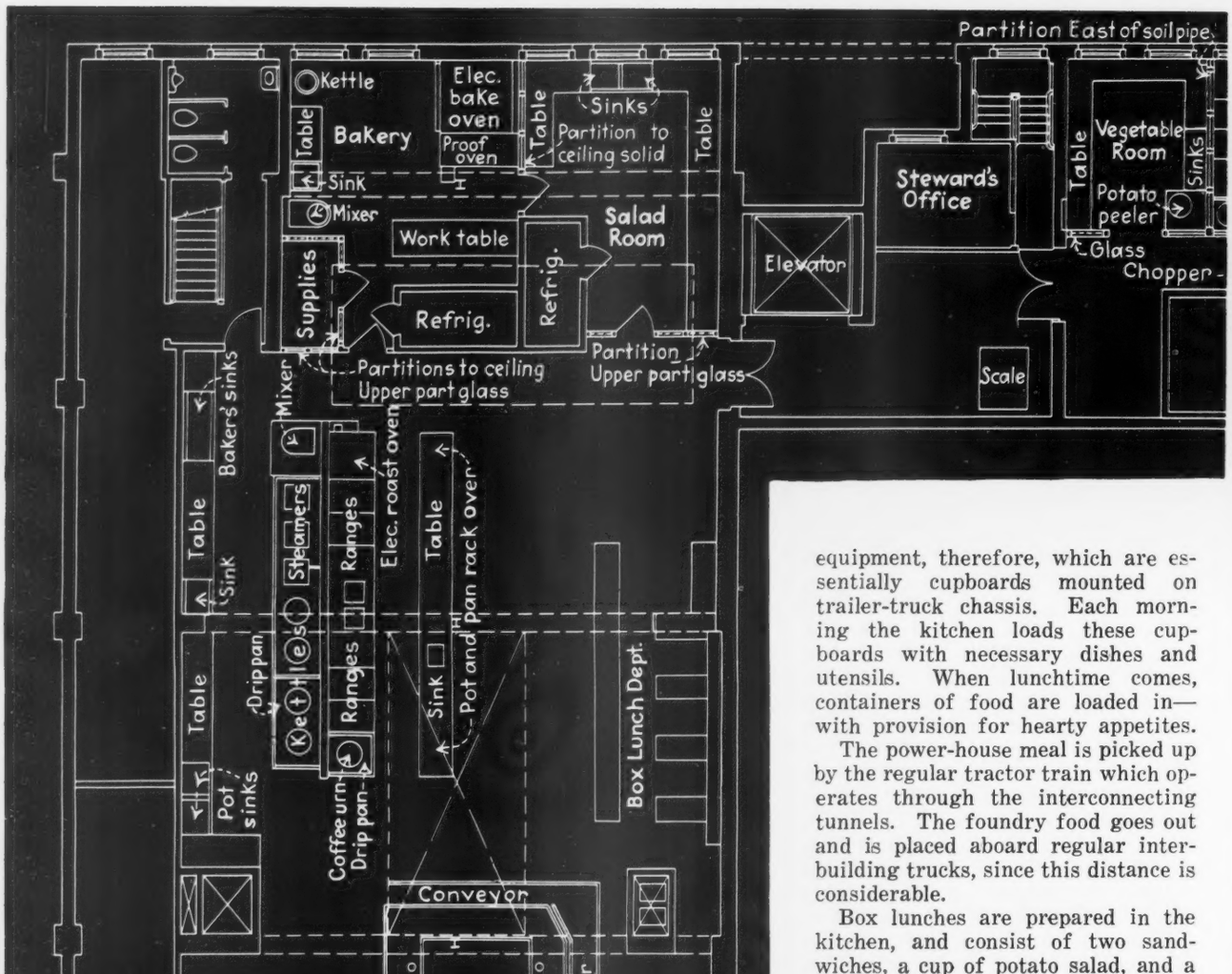
These eight services, with the approximate number of meals served daily, are:

1. Cafeteria for men	1,650
2. Cafeteria for girls	210
3. Officers' Club	100
4. Foundry restaurant	125
5. Power-house restaurant	20
6. Box lunches	400
7. Sandwich stand	250
Total	2,755
8. Pies and ice cream on sale in plant all day:	
Pies per week	1,600
Ice cream cups per week	7,000

The first three—the cafeterias for men and for girls, and the Officers' Club, which is a cafeteria for foremen—are for operating purposes almost a single operation. They are in three separate rooms, all on the first floor of the restaurant building.

Principal item in the men's and girls' restaurants is the plate lunch at 25c for meat, potato, vegetable, beverage, and dessert. Additional items are available at 5 or 10c each. In the Officers' Club the charge is a flat 40c, which entitles the luncher to as much of anything, and as many items, as he desires.

The foundry and power-house restaurants are simply branches of the main cafeteria. Foundrymen and boiler-room workers do not want to take time for a complete clean-up. Our restaurant has several pieces of



Red ink changed to black when NCR installed factory methods in this kitchen, from which eight services for employees are operated

equipment, therefore, which are essentially cupboards mounted on trailer-truck chassis. Each morning the kitchen loads these cupboards with necessary dishes and utensils. When lunchtime comes, containers of food are loaded in—with provision for hearty appetites.

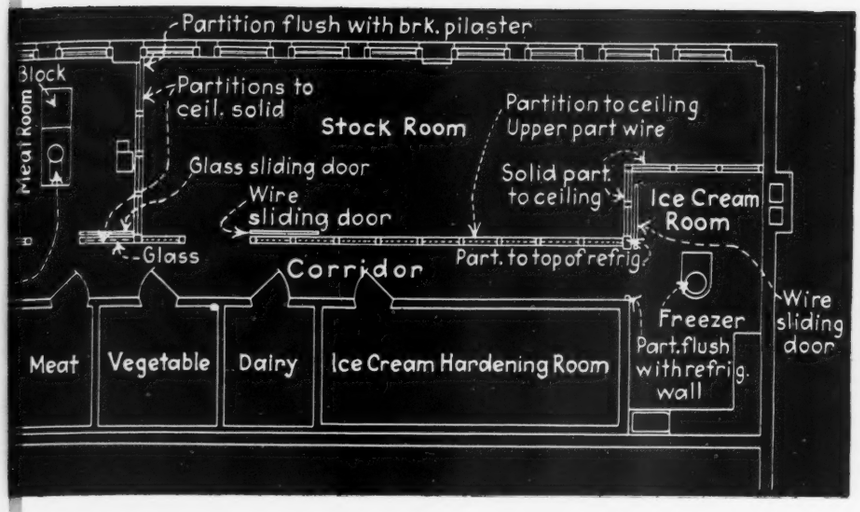
The power-house meal is picked up by the regular tractor train which operates through the interconnecting tunnels. The foundry food goes out and is placed aboard regular interbuilding trucks, since this distance is considerable.

Box lunches are prepared in the kitchen, and consist of two sandwiches, a cup of potato salad, and a piece of cake. Incidentally, in making them up we use regular factory methods. Boxes are placed at the head of a short run of belt conveyor, move along the stations while women place the items inside and close them. They go out to the factory on trucks from which they are sold, and also to the lobby of the NCR Schoolhouse.

Meals at the Movies

The Schoolhouse houses a large group every noon, because motion pictures are shown here free of charge for employees. Features are broken into three parts and shown on successive days as a serial, thus making it possible to see a full-length picture by going for three successive days. And there are no restrictions on eating while the show is going on.

We have now covered all food services except the pies and ice cream cups. These are kept on sale all during working hours. But the actual dispensing is not handled by the restaurant department. Instead, the



restaurant sells them for 4c each to the employees' mutual benefit association, which runs the food stands. The 1c profit goes into the treasury of the benefit association, after paying their cost of tending the stands.

Our entire force is fed in two shifts. One lunch hour is 11.30-12:30, the other 12:30-1:30. Consequently the congestion of eating facilities is minimized.

Plenty of Competition

Perhaps the best measure of the employees' satisfaction with the company food services is the volume and type of competition. There is absolutely none of the saloon or cheap lunch-counter business in our neighborhood. Such enterprises have been started, but they invariably lose money and fold up.

On the other hand, the neighborhood abounds with home restaurants, principally operated in homes by housewives. Many of these restaurant proprietors are considered almost part of NCR; they have been here so long and have such loyal friends in our working force. For the most part they charge a nickel or a dime more than our restaurant for approximately the same meal—the regulars consider the extra cost more in the nature of club dues than of food expense, for they meet daily with their friends and have a materially better opportunity for quiet visiting than they could have in a large dining room at the plant.

When we came to planning our new cafeteria, various capacities were suggested and argued, but we ended with the conviction that 2,000 meals was the proper quota.

No doubt we could have attracted a larger patronage had we built for it; the physical capacity of an employees' restaurant pretty much regulates the demand for its services, since employees will find other ways to eat rather than submit to crowding. But we see every reason why we should encourage the other eating facilities in the neighborhood rather than try to freeze them out of business.

The restaurant building is 154 ft. x 126½ ft., with the dining rooms all on the first floor. The building has an L-shape second story, 53½ x 123 and 100 x 31½ ft., over part of its area. The entire second floor is given over to kitchen and correlated services.

Factory layout considerations influenced the plan of the restaurant building; it is as liberally equipped with machinery as any plant production department. Raw material enters at ground level by an elevator with an outside door, so that it is unloaded direct to the elevator floor. At the kitchen level, the material is unloaded from the opposite side of the elevator, and this opening is in a lobby around which the kitchen departments cluster.

The steward's office is directly opposite, so that the incoming material is accessible for check. A large scale is alongside.

Off to one side, filling the thin side of the L, are on one hand a row of refrigerator rooms, on the other a vegetable cleaning and preparation room, a meat room, a storeroom. In the other direction lies the kitchen proper, as well as dishwashing and similar functions.

Three of the refrigerator rooms—respectively for meat, for vegetables, and for dairy products—are maintained between 38 and 40 deg. F. The fourth, for hardening ice cream and for carrying stocks of quick-frozen fruits and vegetables, is kept at about —5 degrees.

Newest and Best Equipment

In the meat workroom there are three major pieces of equipment besides the ordinary cutting blocks. An electric slicing machine is especially useful for preparing the meats for sandwiches. An electric meat grinder is used for hamburger and meat loaf. And there is an 80-gal. steam kettle, used principally for boiling ham.

Our meat room bones the hams and boils them in aluminum molds such as are used by the packers of canned hams. Right here is an ex-

No ordinary washer this, but a brand-new high-speed type which takes dishes in a continuous flow on a conveyor

cellent example of what modern control means in the operation of a kitchen. By rigid control of temperatures and steam pressures it is possible to turn out a boiled ham with, say, 4 lb. of shrinkage in a 16-lb. ham, where without such control it might easily shrink to 9 or 10 lb., and show a loss on every sandwich served.

In the vegetable room the outstanding piece of machinery is a potato peeler, which will handle 60 lb. of potatoes in 2 minutes, leaving no hand work except removing the eyes with knives.

We purchase ice cream mix from a local source and freeze it ourselves. After it has reached a slightly thickened consistency, it is run into 5-gal. cans which are placed in the hardening room. Or that portion of it which is sold in cups goes into the filling and capping machine which fills each cup to the right depth, puts the waxed-paper cap in place, and closes it tight.

Buy Our Bread

Once, many years ago, we made our own bread, but it proved expensive and yielded no proportionate return. Pies, cakes, muffins, and biscuits, however, are all made in our own shop. A large mixing machine makes the dough, and we use a pie crust roller.

Space limitations do not permit listing more than the major pieces of mechanical equipment which we find advantageous in the kitchen. They run from a special salad refrigerator room to gas ranges, two electric ovens, one for roasting and one for baking, and electric stoves specially for deep-fat frying.

A second mixing machine is used in the kitchen, with all manner of special appliances for such tasks as slicing vegetables, mashing potatoes, whipping cream and salad dressings. Cheese or butter is sliced by one machine; three three-section steam cookers are used; we have two 80-gal. and one 60-gal. steamjacketed stock pots; one 20-gal. tilting kettle is used for cooking stewed tomatoes, or creamed corn.

One 40-gal. stainless steel coffee urn is used solely for making the coffee that goes out to the factory to accompany box lunches. All tables are stainless steel, which would justify its cost if it had no other advantage than its aid in controlling vermin through its scrupulously complete cleanliness.

Dishes are washed by a special machine that was given into our use by the manufacturer on condition that we let him watch it as an experimental unit. It is the fastest type so far developed. It takes the dishes not in batches, not all racked up in baskets, but rather in continuous flow on a conveyor which passes them through the washing chamber and finally lets them emerge upon a drain table where they dry of their own high temperature. We use ordinary batch washers for silver and glass.

Finished food—that is, anything ready to eat—comes down from upstairs not on the same elevator that serves to handle raw materials, but on an entirely different elevator. Reserving it for finished food insures freedom from the outside dust and dirt which unavoidably are found on incoming groceries and vegetables. Deliveries of finished food can be made to the dining room entirely independent of whether some supplier selects that exact moment to deliver a carload of potatoes.

Dirty dishes are carried by bus boys from the tables to an elevator-type conveyor. The tray is shoved upon a belt conveyor which carries it a few feet and delivers it into the elevator shaft where it is lifted to the upstairs floor, and delivered alongside the dishwashing machines. Two of these conveyors are kept running at capacity during the rush.

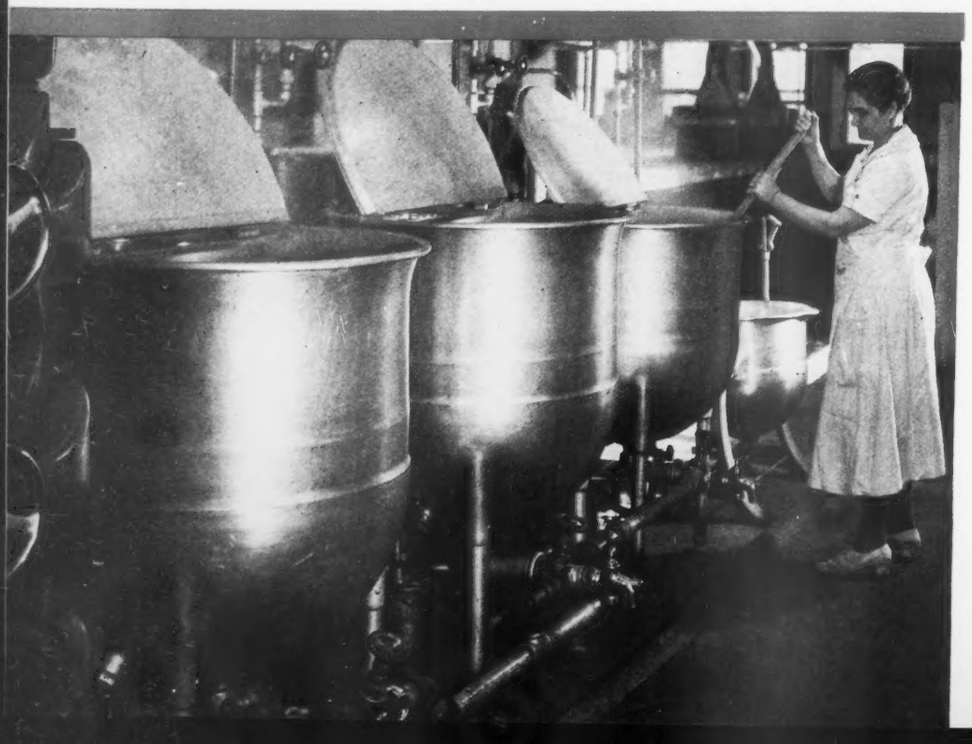
We do not have this equipment simply for the satisfaction of having the job mechanized. Actually, it provides better food than is otherwise available, and it cuts the cost.

Labor Saving, 25 Per Cent

Our estimate—it has to be an estimate, for we never tried hand methods in this kitchen—is that we get along with approximately 75 per cent of the labor-hours in this department that would be required if we had just ordinarily good mechanical equipment. There is no tangible, measurable result in the operations of most of the machines. But we know that without the high-speed continuous dishwasher we should require at least two batch dishwashers. Without the mixing machines, we should need either several old-fashioned machines or a battalion of hand workers.

Nor is it possible to measure numerically just how much better is a French fried potato that comes out of the electrically heated frying stove than the same potato fried by more primitive methods. Nor how much better a great many things taste because they are prepared on scrupulously clean stainless steel tables and hence do not have their flavors contaminated by the memories of yesterday's onions.

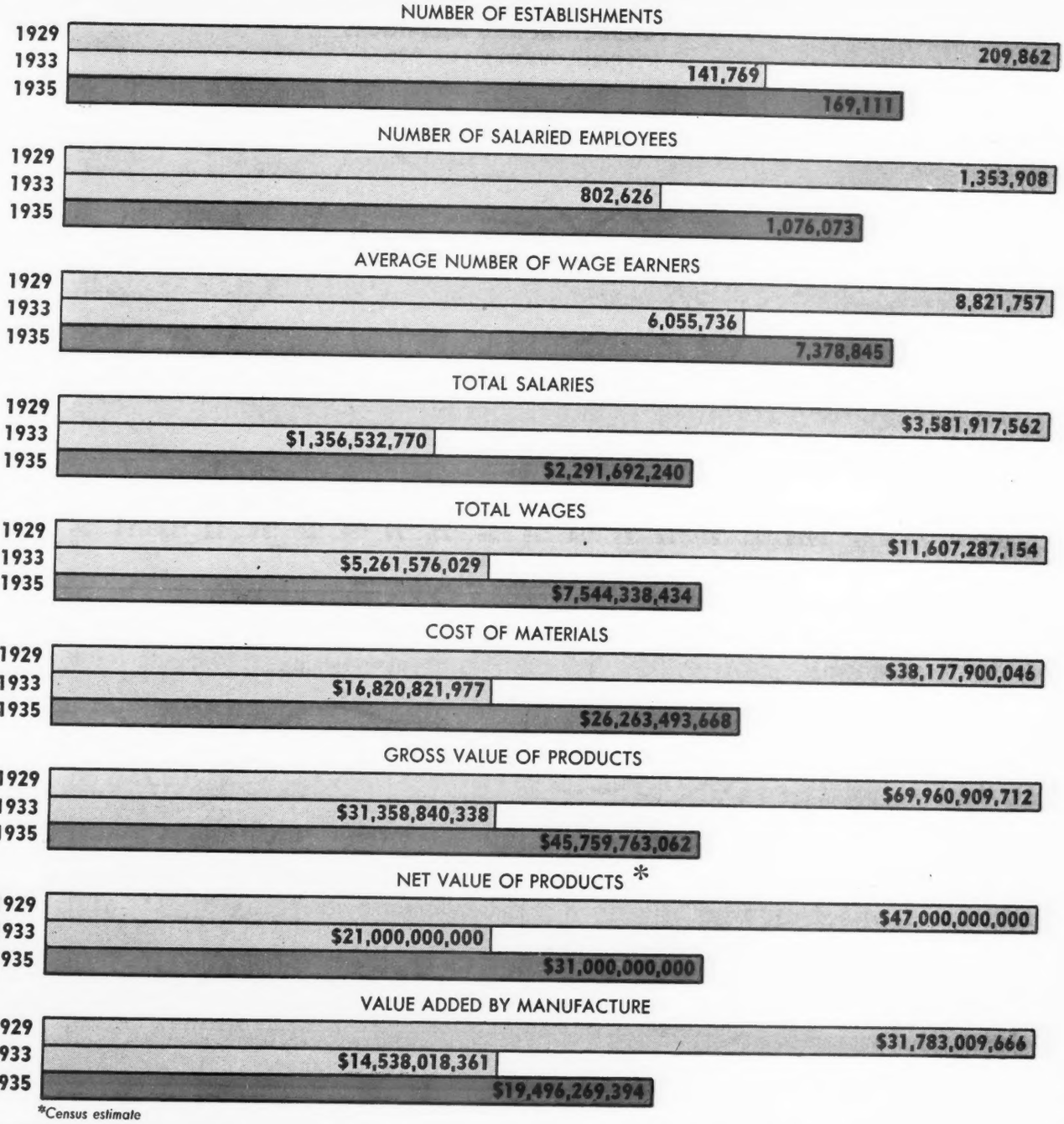
By every measurement we have been able to apply, we are saving money by this new, modern kitchen. We know that our meals taste better. Moreover, added patronage by the employees, plus their favorable comments, shows that they like the food service better than before. And this, after all, is the final test. If we can satisfy their meal requirements, we thereby help to build the kind of employee relationships that are most comfortable and profitable to them and to us.



Kitchen equipment includes two 80-gal. and one 60-gal. steam-jacketed stock pots, also one 20-gal. tilting kettle

Census of Manufactures

United States, 1929, 1933, 1935



*Census estimate

"Number of salaried employees" for 1933 does not include salaried officers of corporations. Salaries of such officers in the same year are likewise excluded from "Total salaries."

"Cost of materials" includes the cost of containers, fuel, and purchased electric energy.

"Gross value of products" is greatly in excess of the true value of manufactured goods, because it includes the value of goods produced for re-manufacture.

"Net value of products" represents the net value, at F.O.B. factory prices, of finished manufactured products.

"Value added by manufacture" is "gross value of products" less "cost of materials."

Source: United States Bureau of the Census.

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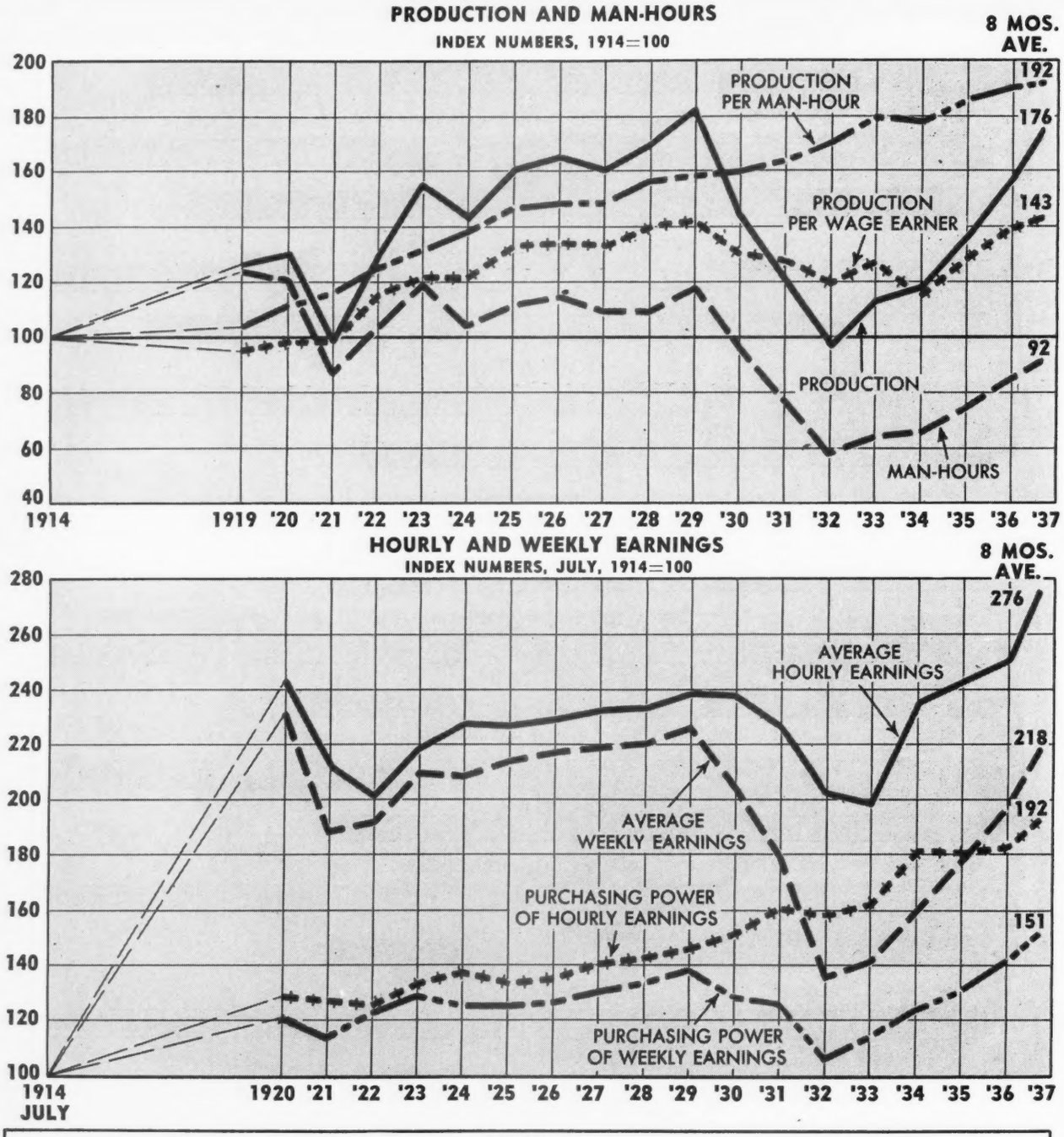
Production, Man-Hours, and Earnings

Manufacturing Industries, United States, 1914-1937



SOURCES

Production, man-hours, and production per wage earner and per man-hour: United States Bureau of the Census, United States Bureau of Labor Statistics, Federal Reserve Board, and National Industrial Conference Board.

Hourly and weekly earnings are derived from the data collected monthly from 25 manufacturing industries by the National Industrial Conference Board.

Purchasing power of hourly and weekly earnings is obtained by dividing the indexes of hourly and weekly earnings by the index of the cost of living.

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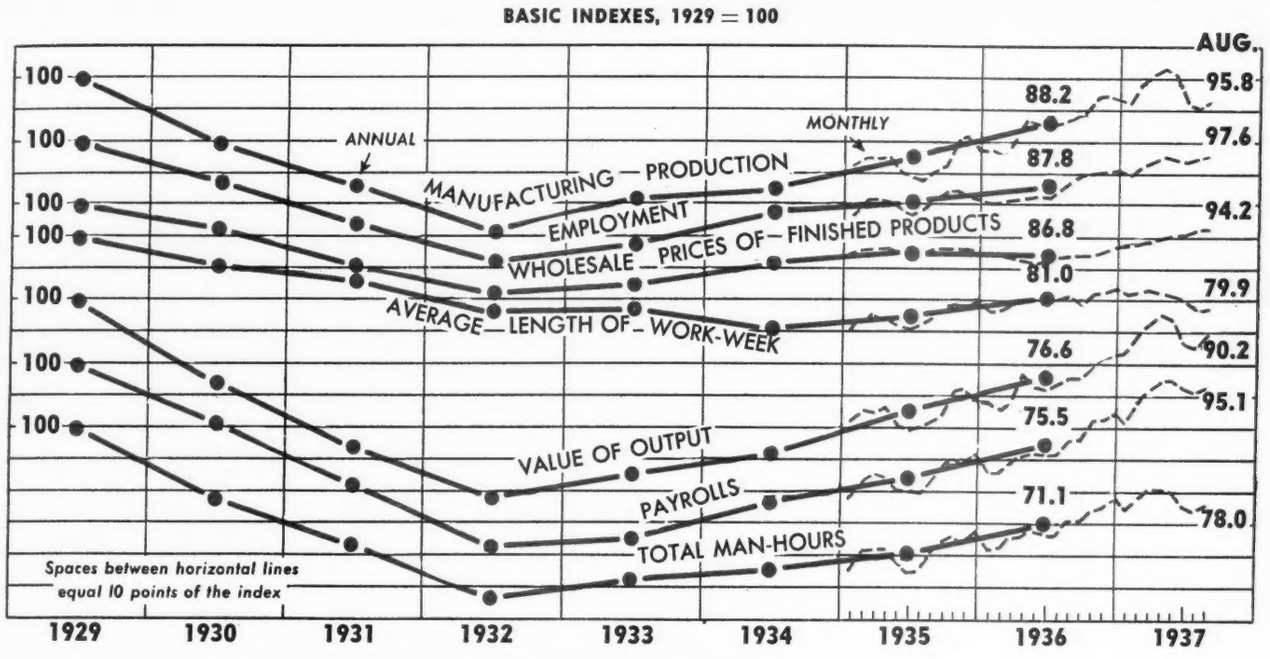
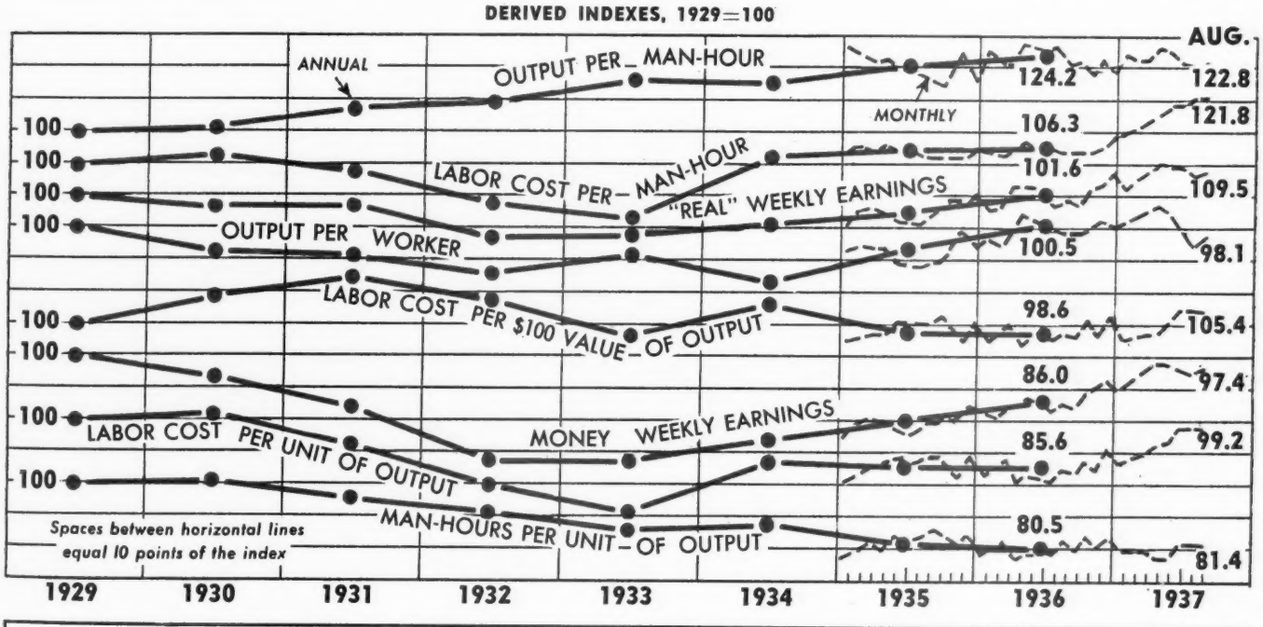
Manufacturing Changes

United States, 1929-1937





PERCENTAGE INCREASE (+) OR DECREASE (−) FROM JULY, 1936, TO JULY, 1937

BASIC INDEXES:		
Payrolls ..... +26.2	Employment ..... +11.5	Manufacturing Production ..... + 5.7
Value of Output ..... +15.0	Total Man-Hours ..... + 9.8	Average Length of Work-Week ..... − 1.6
	Wholesale Prices of Finished Products.. + 8.8	
DERIVED INDEXES:		
	Money Weekly Earnings ..... +13.2	Man-Hours per Unit of Output ..... + 3.8
Labor Cost per Unit of Output ..... +19.3	Labor Cost per $100 Value of Output.. + 9.6	Output per Man-Hour ..... − 3.7
Labor Cost per Man-Hour ..... +14.9	"Real" Weekly Earnings ..... + 8.4	Output per Worker ..... − 5.2

Sources: United States Bureau of Labor Statistics; Federal Reserve Board; National Industrial Conference Board.

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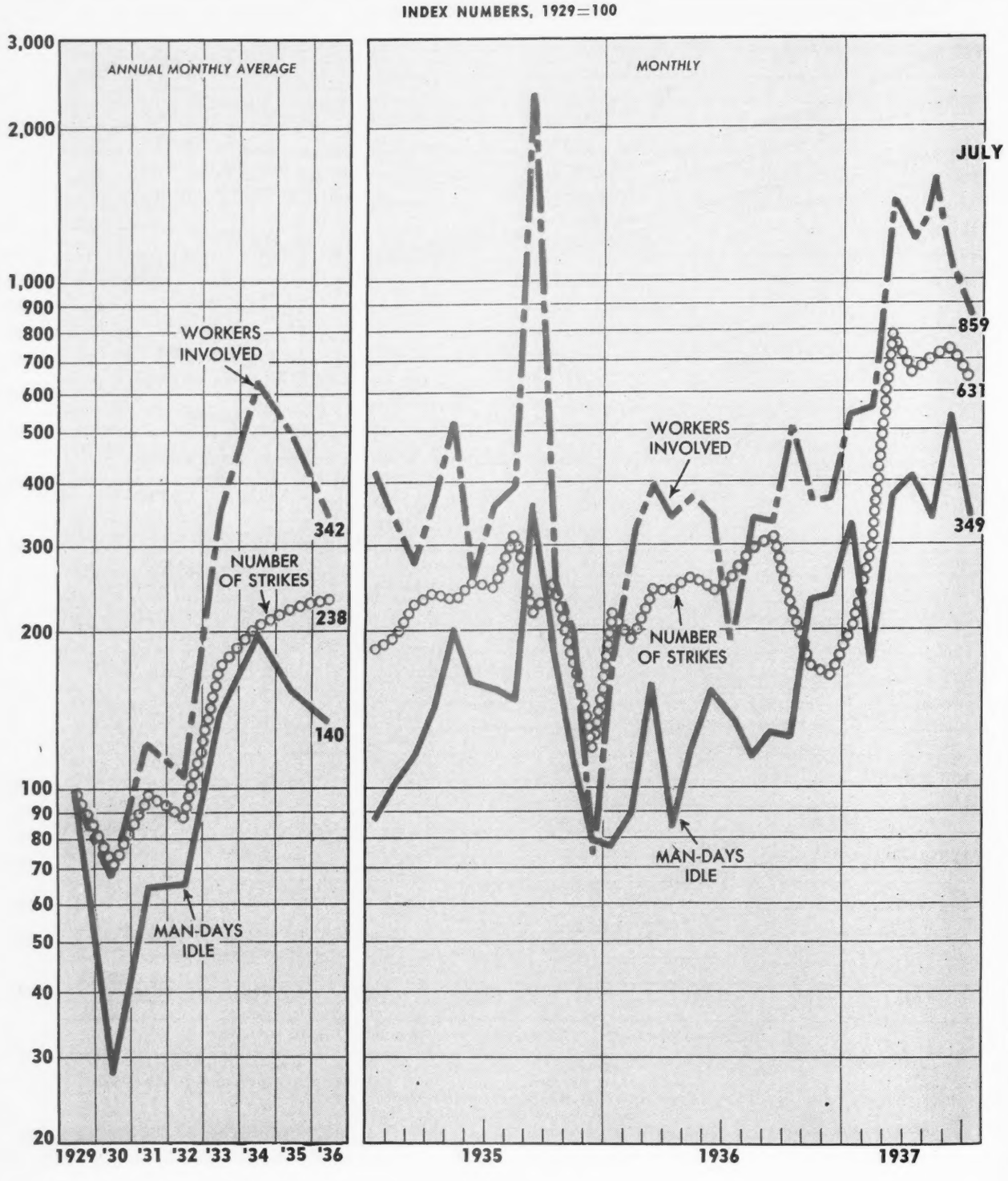
Industrial Disputes

United States, 1929-1937



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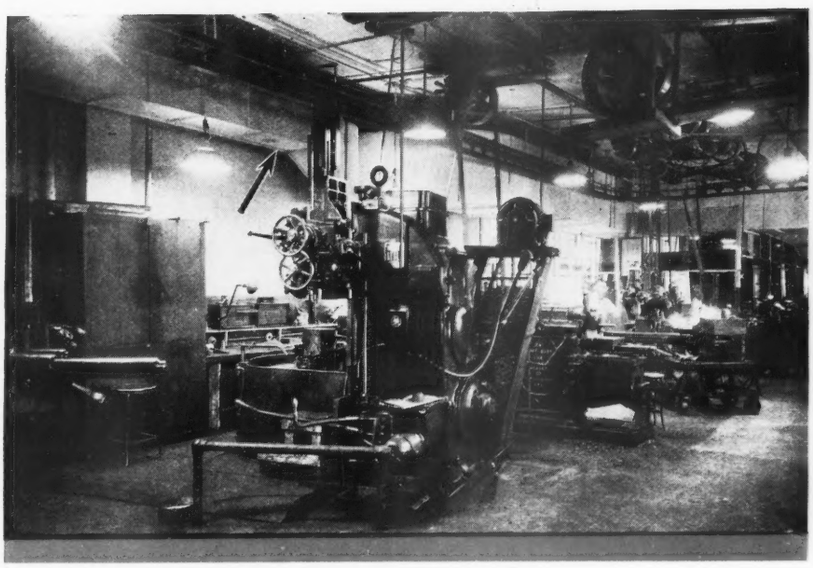


Cooling Down Absenteeism

New air conditioning system responsible. Have you forgotten last summer? Time now to think of next

CHARLES E. CHAPPLE
Superintendent of Maintenance
Doehler Die Casting Co., Toledo

THE PEAK of the die production season comes in the summer months, July and August especially, when conditions for comfortable working are probably the most unsatisfactory. High temperatures, with high relative humidities, require frequent stopping to wipe perspiring brows, discuss the weather, and do the many other things uncomfortable humanity does to offset the heat.

Six Changes an Hour

Two hundred men are employed at our plant in die production, on die repair, and in the machine room. Space occupied amounts to some 340,000 cu.ft. distributed over two manufacturing floors.

To offset hot-weather discomfort, a cooling system was installed and began operating June 1 of this year. Water from a well 600 ft. deep is pumped thorugh a series of coils; a fan, driven by a 25-hp. motor forces the air over the cooling coils and into the duct system which distributes it to the rooms in which the die and machine work is done.

The water in the cooling coils is from 51 to 53 deg. F.; the air is thus cooled below its dew point, and excess moisture is condensed. Air leaves the fan at 60 to 64 degrees.

Each of the rooms is controlled by a thermostat placed in the return grill. This controls the dampers in the return duct system, regulating the amount of cool air admitted to each room. Furthermore, an automatic pressure regulator reduces the fan motor load as inside and outside temperatures approach each other.

The system is a recirculating one, with from 20 to 25 per cent of the air drawn from the outside, and is designed to maintain a 15-deg. difference between inside and outside.

With outside air at 95 deg. dry bulb and 77 deg. wet bulb, for example, the system maintains inside conditions at 80 deg. and 50 per cent relative humidity; 70,000 cu.ft. of air per minute is delivered, and air is completely recirculated six times per hour. Humidity is regulated by reduction of the outside air to the dew point as it goes over the cooling coils with subsequent heating as it comes in contact with the air in the rooms.

Water Used Again

The water circulated through these cooling coils is later used in another air washer which cools and cleans the air for spot-cooling the cast floor. After leaving the air washer, the water is further used to cool air compressors, finally escaping into the sewer at some 90 degrees.

This past fall the unit was used for ventilating purposes; this winter waste hot water will be forced through the same coils, thus supplementing our present steam system and reducing our boiler load.

Figures are not available at present to afford an accurate cost statement of the results of this system since its installation in June. However, no figures are required to convince a person coming into these rooms from the outside that remarkably better working comfort is afforded. The employees like it; some on the day shift have remarked that they were tempted to come back to work at night when heat made sleeping impossible.

There was no heat sickness this past summer, no absenteeism. Nor was it necessary to close the department on especially hot days.

Worth Every Cent It Cost

Costs of operation are elusive. The deep well and connected pump are required to supply water for other purposes. Aside from upkeep and depreciation, therefore, the main cost is that of operating the fan motor.

Results have been so satisfying that extensions will later be made to other departments in the plant not now so provided.

Tunnels for Group Drives

In Republic Steel's wire mill they cut maintenance costs, made it easily possible to use a highly efficient overhead handling system

ARTHUR VAN VLISSINGEN
Consulting Editor

Not a belt in sight; they are hidden behind sheet-metal guards that protect them and the operators

WHEN THE NEW wire mill of Republic Steel Corporation's South Chicago plant was designed, it was considered desirable to avoid overhead shafting and belts for two good reasons. First, incoming material and outbound products of the nail machines are handled overhead. The complications of trying to mix overhead conveyors and overhead drives without tangling the two together are entirely obvious. Second, it was thought desirable to prevent any possible interference with the most effective and economical distribution of good light throughout the department.

Skillful design of the building and layout of the equipment made it possible to obtain all the advantages of group drive, without any of its disadvantages.

Extra Cost Negligible

In planning the building it was necessary to provide for about a 12-ft. fill under the first floor, since the location is naturally swampy because of the river which flows alongside. Machine foundations would have to go well below the fill. It was therefore decided to run a system of tunnels beneath the buildings, their walls being formed by the foundation walls under the machine lines. A large amount of fill was thus avoided; consequently the added cost was negligible.

The tunnels under the nail department are laterals off the main tunnel which carries power lines and pipes for that wing of the wire mill building. Each is 138 ft. long, 8 ft. high, 11 ft. wide.

Two lineshafts for driving the nail machines on the floor above are located in each tunnel. Approximately 104 ft. in length, these lineshafts are $2\frac{3}{16}$ in. in diameter, with $2\frac{15}{16}$-in. section at the motor-driven pulleys, and are mounted on roller-bearing

hangers spaced on 7-ft. 6-in. to 8-ft. 6-in. centers. They are driven at 300 to 330 r.p.m. through V-belt drives by 900 r.p.m. induction motors that range from 15- to 50-hp. rating, depending upon the load. Fourteen nail machines are driven from each shaft, through flat leather belts operating on 12-ft. centers.

As will be seen from one of the illustrations, the motors that drive the lineshafts are mounted on sturdy platforms along the walls of the tunnels, about midway between floor and ceiling. Control equipment for all these drive motors is located conveniently on the machine floor.

Maintenance costs have been reduced in half a dozen ways by having the drives below the floors. Everything is completely accessible from floor level, either in the tunnel or on the main floor. Ladders have disappeared from lineshaft and belt maintenance, and with them has gone the time cost involved in climbing up and down, in having a helper steady the ladder, and so on. Moreover, men working on solid footing just naturally turn out more units of work output per hour than men balancing themselves precariously overhead.

No Chance to Fall

Still another advantage is the lessened danger; a man could hardly fall and hurt himself on the tunnel floor as seriously as is the inevitable result of slipping off a stepladder.

Maintenance is on a regular schedule, with millwrights and electricians looking over the equipment at regular intervals unless called sooner because of trouble. All belts are inspected weekly for tension, condition of the lacings, grease, and the like. Motors are checked from four to thirty times a month, depending on the importance of the unit. Hanger bearings get an inspection and greasing every four weeks.

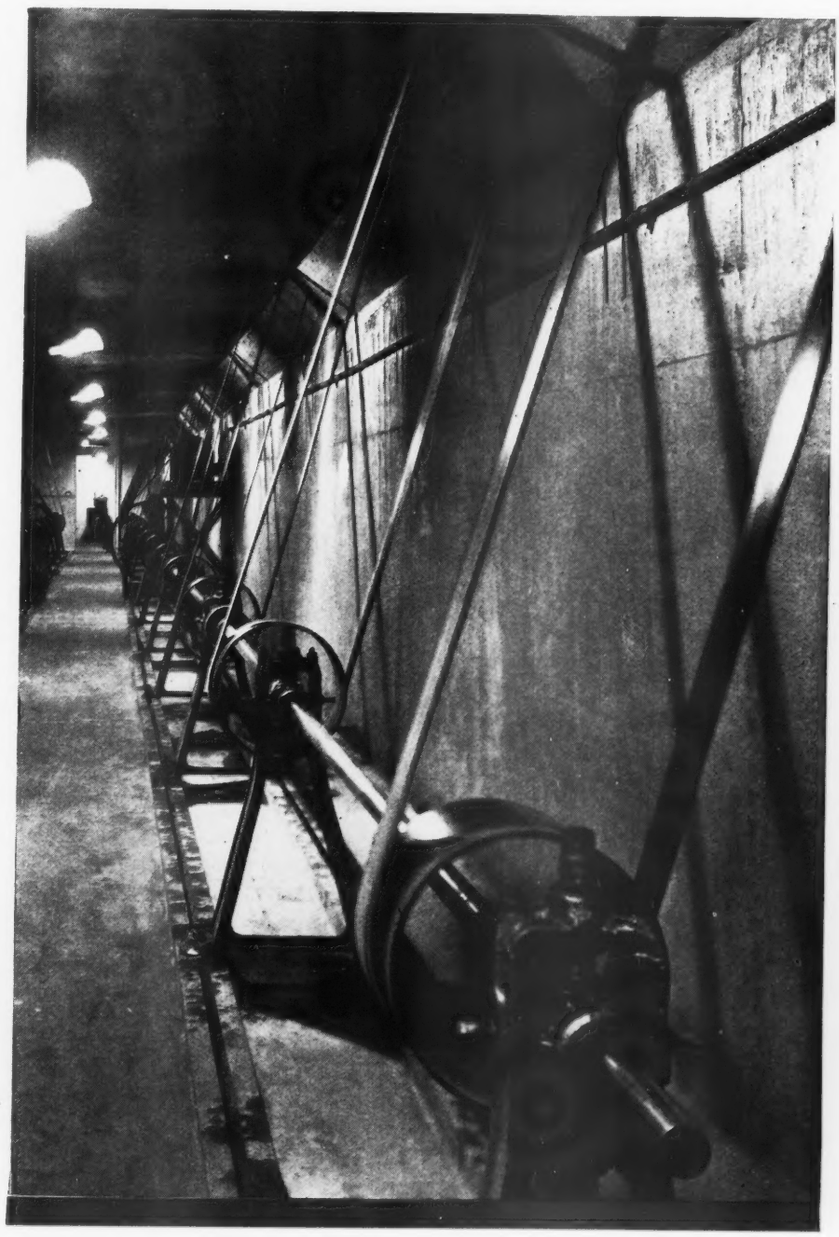
Because everything is in clear sight, the maintenance men have unobstructed vision of everything they need to look at, which has the psychological effect of making them more painstaking than they might be if careful maintenance involved more effort and greater difficulties. As every maintenance chief knows, it is a lot more effective to make good maintenance pleasant than to keep cracking the whip.

As was mentioned previously, having the lineshafts under the floor makes possible better mechanical handling. The essence of the nail department layout is that nails come out of the automatic machines into tote boxes; these boxes are dumped into nail buggies which are essentially like the two-wheeled concrete buggies used on construction jobs, except that the nail buggies are more heavily built to stand the greater weight of the load.

These buggies are then picked up by a 2,000-lb. monorail cab crane and carried overhead to the balcony where they are dumped into cleaning tumblers. With overhead drives it would be practically impossible to employ this cost-saving type of handling, even though group drive is far better adapted to nail machines than is individual drive.

The under-floor drives do not, of course, interfere in any way with the lighting, which means better working conditions both in the daytime—the building is single-story—and under artificial lighting.

All told, the advantages of under-floor group drive are so many the plant executives feel that if it had been necessary to dig the tunnels instead of merely fail to fill them in, it would have been good business to do so, in order to get motors and lineshafts and belts out of the way.



In the tunnels under Republic Steel's nail department, the lineshafts are out of everyone's way

What Instruments Are Doing for the Other Fellow

They can do for anyone, when it comes to locating trouble, keeping tab on operation, and giving information only they can get

R. H. SCHRADER
Meter Division, General Electric Company
Schenectady, N. Y.

A MACHINERY manufacturer was purchasing power from the local utility under a contract in which the demand charge was based on 90 per cent power factor, with a penalty for all power used at a lower power factor. For several years the power factor of the plant load was often less than 70 per cent, which gave poor operating conditions and necessitated the payment of a substantial penalty each month. Complete tests made with portable indicating instruments on all transformers showed that the principal cause of low power factor was two second-hand transformers which were being used for welding. These transformers were not properly designed for the job, and therefore operated with large losses and low efficiency. Improper loading of other transformers and some of the circuits also fostered low power factor.

Saved $514 on Demand Charges

As a result of the tests, the two second-hand transformers used for welding were replaced with a new one designed for the purpose, a capacitor was installed, and the loads on other transformers and circuits were redistributed, giving better conditions and higher efficiency.

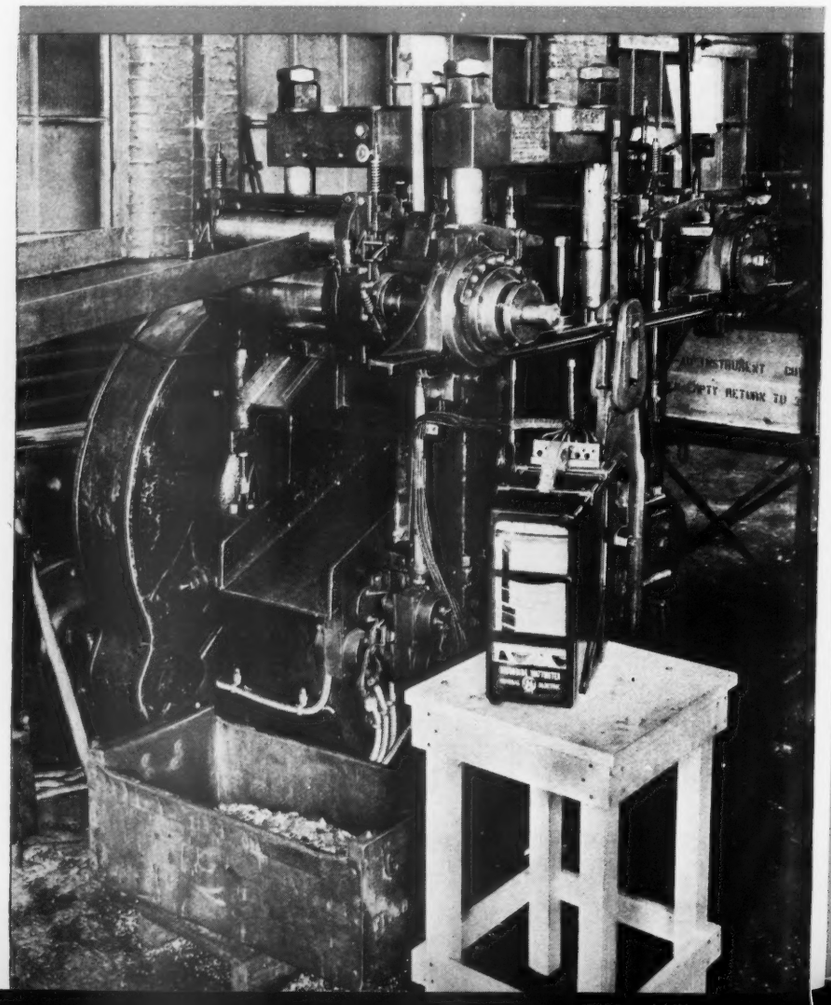
These changes raised the power factor from approximately 65 per cent to 92 per cent. The first month's savings were $514 on demand charges alone. These savings vary from month to month, but they are substantial and continuous. The cost of the new transformer and capacitor was partially offset by the scrap value of the two old transformers, and the savings made each month will soon pay for them.

A large oil refining company uses indicating instruments to determine the load on certain pump motors which are required to operate 24 hr. daily, seven days a week. A red mark on the scale of the instrument indicates the loading limit. The position of this mark had been carefully calculated so that a satisfactory ratio of production could be maintained with an ample factor of safety on the equipment.

It was suspected that one of the night operators was running this pump at reduced load, because tripping of overload protection devices caused him considerable work in clearing the system and getting it into operation again. No definite proof could be obtained, however, until a recording instrument was connected in the circuit. This recorder definitely showed that the load was reduced during the night shift. When faced with the records, the operator admitted his practice of running at reduced load.

Production Stepped Up

Production was stepped up considerably, of course, when the pump was operated at schedule load. Since



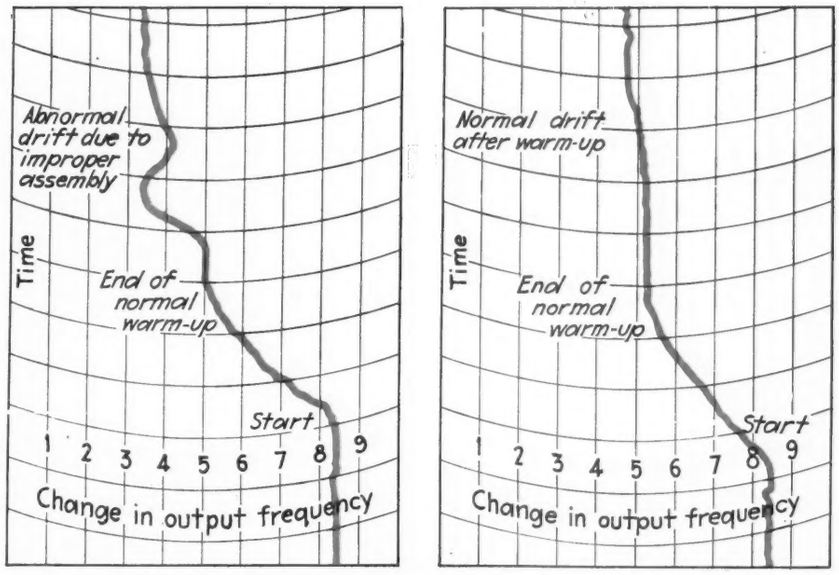
A recording wattmeter tells the operator when the dies on this punchpress need sharpening

that experience the company uses recording instruments to check this and similar processes, in order to make sure that production is kept at a satisfactory level consistent with safety factors desirable.

Checking industrial operations by the use of recording instruments is not confined to machines already in service. Here is an instance where a rotary digester was tested before final installation. It was supposed to require about 3 hp., but the instrument record showed an input up to 12 hp., with 41 such peaks a minute.

The machine was thus discovered to be faulty, the shaft being sprung and the bearings out of line, and proof was right at hand to convince the manufacturer of the machine that these conditions existed. Delays in production and other losses were prevented by discovering that the machine was defective before, rather than after, it was installed.

This same instrument was used to test a molasses pump. Its record showed the average and maximum power input, and the strokes a minute. A sharp drop in input for several strokes indicated failure of the cylinders to fill with molasses. After it became known that this condition existed, it was a comparatively easy matter to correct it.


Abnormal drift due to improper assembly
Time
End of normal warm-up
Start
1 2 3 4 5 6 7 8 9
Change in output frequency
Normal drift after warm-up
Time
End of normal warm-up
Start
1 2 3 4 5 6 7 8 9
Change in output frequency

No one knew that a radio transmitter had been improperly assembled, until a meter proved it by the chart at the left. The chart on the right shows normal operation

Why Motors Overheated

A motor-driven coal pulverizer is part of some new boiler room equipment which has recently been installed. This pulverizer is driven by a 40-hp. motor, which was found to be running hot in service. A check with an indicating ammeter showed that the motor was overloaded. A recording wattmeter was then connected in the motor circuit and, although the load was found to be variable, the wattmeter record showed that the motor was overloaded at times, peaks of 75 hp. being reached.

Study showed that by reducing the size of coal fed to the pulverizer, the load could be reduced from peaks of 75 hp. to approximately 35 hp., which is well within the rating of the motor.

This same company made a test on a motor driving an air compressor, which had been reported to be running hot at various times. The motor was rated 10 hp. but the meter showed that the load was slightly more than 15 hp. for several hours a day. Study of the operating cycle, as shown by the charts, made it possible to adjust the loading so as to protect the motor from such dangerous overloads.

In another plant considerable trouble had been caused by frequent tripping of the overload device protecting a motor that drove a vacuum pump. A recording wattmeter connected to the motor showed that it was continuously badly overloaded. The record convinced the maintenance department that the trouble was in the pump. Further investigation showed that the pump was full of water which had leaked in from faulty packing.

The temperature indicator on a 100-kva. transformer showed that it had reached 90 deg. C., indicating a severe overload. Inquiry failed to place responsibility for the overload; so a recording ammeter was connected to various circuits supplied from this transformer. The charts obtained showed very clearly the cause of overload: Several electric ovens in the laboratory were being used simultaneously, and a home-made heater had been installed in the gatehouse.

By properly spacing the use of electric furnaces in the laboratory, and cutting off the home-made electric heater, the trouble from overloading was easily overcome.

A nationally known paper manufacturer operates 24 hr. a day seven days a week, and it is extremely important that there be no interruption in the production of paper. This company uses recording instruments on all important machines. An instrument patrol reads them at regular intervals, to make sure all equipment is operating satisfactorily, and changes charts when necessary.

This company has found the recording instruments to be extremely useful, not only in giving a running record of production processes but also in assisting the electrical department to anticipate various kinds of mechanical and electrical troubles before they become serious enough to cause an interruption in production or damage to the equipment.

To Find Out Who Did What

Furthermore, these recorders have been very useful in definitely fixing responsibility for troubles after they have occurred. A very close watch is kept on all cases of production delays, and a strict accounting by the departments or individuals responsible is called for by the management. By definitely fixing the responsibility for production delays the instruments have thus contributed greatly to the production efficiency of the plant.

One of the first steps in the manufacture of paper is the mixing of the wood pulp and water with other ingredients, in large beaters. The recording instruments have been found to be of distinct advantage in obtaining the following information:

1. Checking the total number of charges made in a 24-hr. period. This record serves as a check on the operator's record and on the raw materials used in a 24-hr. period.

2. The record also serves as a check on proper operation of the

(*Continued on page* 155)

Door Open, But No Draft

Unit heater drops curtain of warm air over door opening, protects men on end of Oldsmobile line from wintry breezes

J. J. CARTER
Manager of Manufacturing
Olds Motor Works
Lansing, Mich.

VARIOUS DEVICES for keeping out cold air in winter have been tried in our plant with indifferent success. Electrically operated doors and air-operated doors move too slowly to be entirely satisfactory. Again, someone may neglect to push the buttons quickly enough, with the vociferous complaint of the workmen affected by the blast a natural result. With frequent blasts of cold air from the outside, it is impossible of course to maintain an even and comfortable working temperature near openings.

Doormen Too Costly

To reduce complaints, we tried installing operators at these large openings whose duty it was to open the doors, by air or electricity, at just the right time, and to close them promptly after the car had passed through to the shipping dock, or the railroad car or truck had been shunted into the building.

But this solution was costly. To the wages of the operator assigned to this duty, the cost of the air or electricity used plus maintenance costs of the operating system, had to be added.

After trying all these devices commonly used, we decided to adopt something quite different—the "air curtain," an adaptation of the unit heater. By an appropriately designed duct system, the warm air current created by the fan is blown down over the opening, thus serving as a door seal.

Today the door-opening problem no longer exists. The "door" is a curtain of warm air forced downward, shutting out the cold air to a large extent, and mixing with the air that does filter through, thereby maintaining a more even temperature than had hitherto been possible with any combination of door-opening mechanisms.

The accompanying photograph illustrates this installation at the end of the assembly line where the cars are driven out of the assembly building to the shipping dock. The duct system leading from the fan is just the width of the opening to be covered. Baffles direct the air at any angle desired, in this case directly downward, toward the floor.

Cost of operation and installation is approximately that of any unit heater. In fact, this unit replaces a heater that would normally be installed near the opening closed by the usual door. The opening, 7 by 12 ft., requires a free air capacity of 5,300 cu.ft. per minute.

Cost $600 to Install

The cost of steam used in the heating coils and the electricity to drive the fan is 22c per hour. The cost of installing fan, heating coils, motor, and hood was $600.

Several similar installations have been made at various points around the plant. In every case complaints by the workmen of cold wintry blasts have been eliminated, and at a moderate cost compared with that of operating a door.

What Protection with Control?

With low-voltage release, motors will start automatically after voltage failure; if they must not, low-voltage protection is needed

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WHEN SELECTING or applying motor control apparatus, the question of when to use low-voltage protection, and when low-voltage release is preferable, frequently comes up, and should always be considered. These terms applied to control equipment describe the application of simple principles that can readily be understood, but their significance is often overlooked.

Low-voltage protection means protection for the motor, the load, and the operator, against unexpected restarting of the equipment upon return of full line voltage after extremely low line voltage has caused the control to disconnect the motor from the line.

Low-voltage release means automatic restarting of the motor upon return of full line voltage after extremely low line voltage has caused the motor to be disconnected from the line.

With control equipment low-voltage protection is obtained by spring-return handles on starting boxes, reset contacts on drum controllers, and spring-return pushbuttons for magnetic-switch starters.

A starting box handle is moved throughout its travel against its own spring pressure and is held in the full running position by a line voltage coil which lets go on low voltage, allowing the handle to fly back to the Off position. Figure 1 illustrates this scheme.

A drum re-set contact is closed only in the Off position of the drum and is connected in the coil circuit of a protective magnetic line switch which, in turn, has an auxiliary contact to bridge the re-set in all other positions of the drum, as shown in Figure 2. Upon voltage failure the magnetic line switch and its auxiliary contact open, requiring that the drum be brought to the Off position before restarting can take place.

Similarly, on any automatic control the magnetic line switch, Figure 3, has an auxiliary "make" contact to bridge a spring-return Start pushbutton so that finger pressure on the latter need not be maintained.

All these devices operate to give low-voltage protection by preventing unexpected restarting upon sudden return of normal line voltage. The starting operation must be repeated purposely by the operator.

On the other hand, the omission of springs on starting box handles, resets on drum controllers, and the use of maintained-contact pushbutton stations operates to restart the equipment immediately upon restoration of normal line voltage after a

(Continued on page 144)

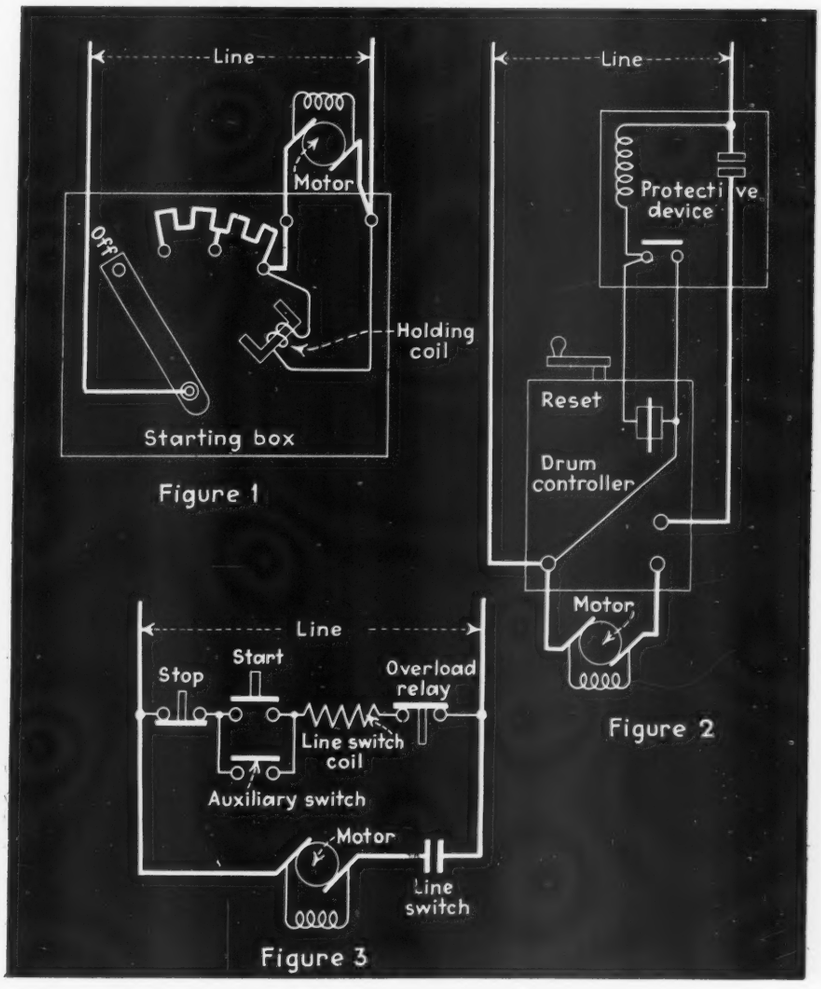


Figure 1. When voltage fails, a spring returns the arm to the Off position. In Figure 2 the reset is closed only in the Off position of the drum controller. Both pushbuttons in Figure 3 are spring-return, All of these arrangements give low-voltage protection

They Profited by Raising Power Factor

C. W. LEIHY
Editorial Representative, Pacific Coast

1 Replacing a 200-hp. motor with two 75's, plus a 190-kva. capacitor, raised power factor in a wire rope plant to 95 per cent, saves $80 a month

2 At an oxygen plant a 160-kva. capacitor cost $1,850, raised power factor to 99 per cent, saves $1,000 a year

3 A flour mill changed induction motors to synchronous type. Higher efficiency and power factor save this concern $3,600 annually

4 Installing a capacitor and buying primary power gave a brewery 97 per cent power factor, will save $300 a month from now on

MANY plants have found that correcting low power factor is a good way to reduce production costs, through the resultant lower rates for energy, improved efficiency, better voltage conditions, and the release of extra electrical capacity for useful work.

Why these results follow improvement in power factor can be seen if it is remembered that power factor expresses in percentage form the ratio between the current or amperes convertd into useful work to the total amperes in the circuit. As an example, a circuit operating at 100 per cent or unity power factor and carrying 80 amp. will perform the same amount of useful work as a circuit carrying 100 amp. at 80 per cent power factor. In the latter case 20 extra amperes are necessary to supply magnetizing current to motors or other equipment in the circuit.

In circuits having a lagging power factor, a component termed "wattless current" circulates through the conductors without doing work. Although they cannot be converted into usable energy, the wattless amperes are just as effective as their working brothers in creating resistance losses in the conductors, and their presence eliminates room for an equal number of power-producing amperes. Therefore, a 100-amp. circuit is only 80 per cent efficient, in terms of its ability to do useful work, when the power factor is 80 per cent and its losses are just as high as though it were carrying 100 amp. at unity power factor. By raising the power factor to unity, the same conductor can handle a larger motor load with the same losses.

Three Ways to Raise

Today the most popular methods of raising power factor are: (1) Use of synchronous motors; (2) use of static condensers or capacitors; (3) operating induction motors at approximately full load. Which of these methods, singly or in combination, should be used, depends on the circumstances.

As an example, in the plant of the E. H. Edwards Company, wire rope manufacturers, the wire-drawing bench was driven by a 200-hp. induction motor. Tests showed it to be operating on an average load of 100 hp. In this underloaded condition the motor required 90 reactive kva. By substituting a 150-hp., unity power factor synchronous motor requiring no reactive kva., and taking advantage of the 60 leading kva. delivered by virtue of the 60 per cent loading on the motor a gain of 150 reactive kva. could have been made.

This plant was operating at a power factor of 65 per cent, with a monthly consumption of 115,000 kw.-hr. and 125,000 reactive kva.-hr. The wire-drawing bench operated an average of 480 hr. a month.

With the synchronous motor drive, the reactive kva. would have been reduced about 72,000 kva.-hr., which would have raised the plant power factor to 90 per cent. If a 150-hp., 0.8 power factor motor had been selected instead of a unity power factor machine, 127 corrective kva. would have been available when operating at two-thirds load over a monthly period. This net gain of 217 reactive kva. would have decreased the plant reactive kva.-hr. to 20,000 a month and increased the power factor to 98 per cent.

Net Saving, $80 a Month

Raising the plant power factor from 65 to 98 would mean a net saving in power bills of $80 a month.

For various reasons the means adopted for correcting power factor consisted of replacing the 200-hp. motor with two 75-hp. induction motors and adding a 190-kva. capacitor. The power factor was thus raised to between 95 and 97 per cent.

Underloaded induction motors are

the most prolific source of low power factor. In this instance the 200-hp. induction motor operating at 50 per cent load required 90 reactive kva. If this motor had been replaced with a modern 100-hp. induction motor, which requires approximately 37 reactive kva. the net gain would have been 53 kva. for 480 hr. or 25,500 reactive kva.-hr. The power factor would have been raised from 65 to 75 per cent, a gain of 10 per cent with a reduction in penalty of 2.5 per cent, or $25 a month.

The new motor would have cost around $700, making the return on the investment approximately 40 per cent. The effect would have been the same as though a 53-kva. capacitor had been installed. At a cost of $11 a kva., plus 5 per cent installation cost, the total cost of the capacitor would have been a little over $600. (In this example the capacitor would have been cheaper than the new motor.)

If the plant had had a spare 100-hp. motor, however, or if the motors on several drives could have been changed around to produce better loading, the cost of the corrective kva. would have been very small. Correct loading of induction motors usually will not increase plant power factor high enough to earn appreciable bonuses, but every reactive kva.-hr. gained in this way reduces the capacity of other corrective apparatus necessary to attain larger bonuses and as such it is worth at least $11 a kva. to the management. This point should not be overlooked.

Earned a Bonus

At the plant of the Stuart Oxygen Company, San Francisco, an average monthly consumption of 230,000 kw.-hr. at 84 per cent power factor cost $2,315. The reactive kva.-hr. at this power factor totaled 150,000. Analysis of the load showed that a 160-kva. capacitor operating continuously would supply corrective capacity equal to 115,000 kva.-hr. At the 230,000-kw.-hr. load, this would make the power factor 99 per cent, and earn a 4.8 per cent bonus under the power company's contract.

The cost of the capacitor installed was approximately $1,850, an investment which earns $1,000 annually, or a return of 54 per cent. This return does not capitalize the system capacity released in this way for useful work.

Generally speaking, the low first cost of a capacitor, the fact that installation costs are low (about 5 per cent), and that only trifling maintenance is required, tend to produce a high rate of return on money thus invested.

In the mill of the Sperry Flour Company, South Vallejo, Calif., there are two lineshafts each formerly driven by 400-hp., 300-r.p.m. induction motors. It was desired to raise the power factor, to obtain a bonus. By adjusting motor loads small improvements were made, but investigation of the other conventional methods of correction did not show a particularly high return on the investment necessary.

A Return of 33 Per Cent

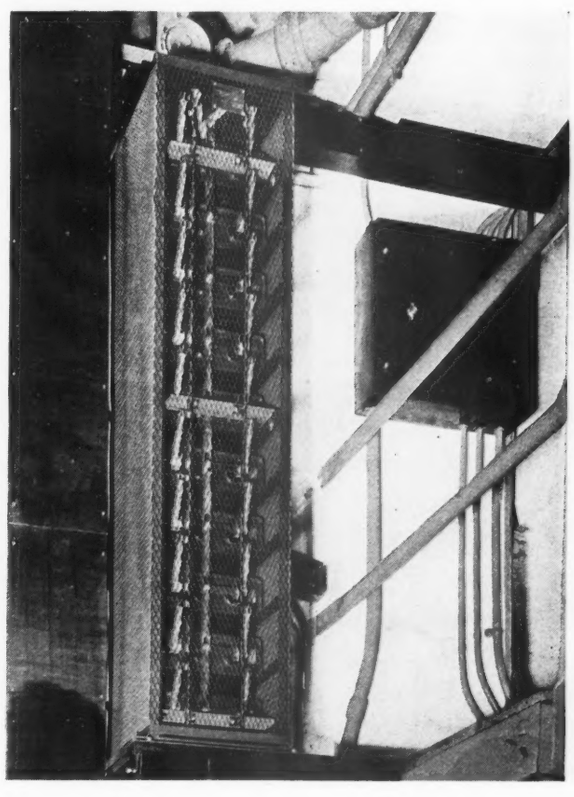
Eventually it was decided to change the two large induction motors to the synchronous type. The manufacturer supplied two new rotors without shafts, since the old shafts could be used, collector ring assemblies, small motor-generator sets for field excitation, and the necessary starting equipment. One motor was changed over at a time leaving one lineshaft operating. Total cost including labor and materials was approximately $11,000, and when completed the plant power factor was raised to unity. The reduction in power costs due to improved efficiency, plus the bonus earned on the power factor clause, amounted to $300 a month or $3,600 a year, giving a return on the capital investment of 33 per cent.

Another very interesting electrical study was made at the plant of the Cereal Products Company, San Francisco. This plant has a demand of approximately 600 kw. and an average monthly consumption of approximately 175,000 kw.-hr. The plant power factor varied between 84 and 97 per cent, with an average of 87 per cent. By the installation of a 100-kva. capacitor giving 65,000 reactive kva.-hr. the power factor was raised to a maximum of 99 with an average of about 97 per cent. Under the rate schedule this represents an average saving in power costs of between $100 and $150 a month.

A further saving was made possible by changing over to another rate schedule under which the customer is permitted to purchase power at the primary voltage, furnishing his own transformers to provide the distribution voltage. Despite the fact that the transformer losses were calculated to be 7,100 kw.-hr. a month, with an increase in demand of 9.8 kw., the additional savings made possible by purchasing 600 kva. of transformer capacity to qualify under the rate schedule average around $300 a month.

Saved Floor Space

Both the transformers and the capacitor used in this installation are filled with a non-flammable insulating medium, which makes it unnecessary to install them in a fireproof vault. Therefore, they were mounted under the ceiling of the engine room, thus saving valuable floor space for other useful purposes.



A 100-kva. capacitor in a San Francisco brewery paid for itself in a year. To save space it was mounted 15 ft. above the floor

When Wiring Your Plant

Careful planning of secondary distribution systems is essential for good design, neat appearance, and safety to men and equipment

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LAST MONTH circuit arrangements for primary distribution were discussed. In this article, layouts for secondary distribution will be considered.

Secondary distribution usually is at one or more of these voltages: 550, 440, 220, or 110 volts, nominal rating. In this discussion it is assumed that the voltage has been selected in accordance with the principles outlined in preceding articles, and that the secondary circuit will therefore be relatively short. But even though such circuits are short, they are important, and the details of their installation need to be carefully watched.

Heat dissipation in particular is more important because the ampere loads are usually higher than in primary circuits. One of the illustrations shows what happened to cable insulation installed where it was too hot, as the result of insufficient planning. Choice of the correct cable would have eliminated replacement for many years.

A Job for the Expert

One point must be emphasized in particular. Layout of the physical arrangement of circuits is one of the most difficult problems facing the electrical designer. Anyone can throw together a mass of conduit in such a manner that cables can be pulled through the individual pipes. But a good, economical, safe, and neat design can be obtained only by skillful designers.

Except for outdoor installations, where the conductors can be well separated to prevent accidental contacts of any kind, bare wiring is not to be recommended. Where it must be used it should not result in a maze of inaccessible and hazardous storks' nests on roofs or poles, or criss-crossing without rhyme or reason. Because the conductors are bare, they must be treated with more care.

There is very little to be said about the manner of installing bare conductors, since the details have been so standardized that they can be found in many publications. When planning circuit arrangement it is necessary to consider carefully both the National Electrical Code and the National Electrical Safety Code in order to solve the many problems that call for special construction in industrial plants to insure safety to men and equipment.

Where frequent changes in the location of equipment are to be expected, it is frequently desirable to carry one or more circuits in continuous metal chutes or boxes which are arranged so that a circuit can be tapped off quickly wherever required. Several flexible distribution systems of this sort are available.

In all conduit installations in industrial plants, many splicing boxes and fittings are required, and it is advisable to standardize on as few types as possible. In so doing it is important to see that fittings that are poorly made or of sub-standard thickness be avoided. Only good, standard fittings should be used. If the principles expressed previously in these articles are followed, there will be a minimum of splicing boxes, resulting in neat arrangement and a minimum of trouble in installation.

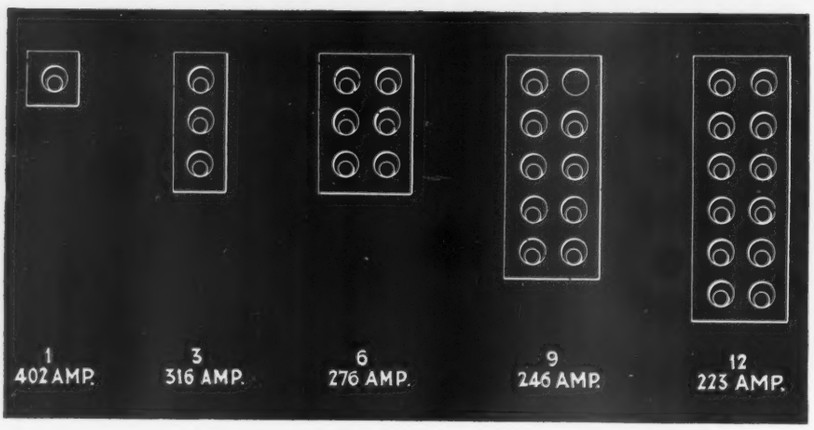
There is such a variety of high-grade splicing boxes on the market that practically anything desired can be obtained. Frequently selection is largely a matter of taste.

Better Off Underground

As a general rule, underground installations of both primary and secondary circuits always can be considered to be best. Accident hazards are reduced to a minimum, the cables are in cool earth where their ampere capacity is greater, and they are not in the way if it becomes necessary to make any changes above the floor. The cost of putting cables underground is not always justified when these conditions are met:

1. Unsuitable soil conditions;
2. Destructive chemical ingredients are present;
3. Imminent major changes in plant layout will require re-routing cables.

When underground ducts are used, however, fiber conduit incased in concrete is the most popular. Where traffic is light and the weight over the duct line comparatively



Maximum current ratings of a three-conductor, 500,000-circ.mil, 15-kv., paper-insulated, non-shielded, lead-covered cable installed in duct banks in the earth. Ambient temperature is assumed to be 20 deg. C., with 100 per cent load factor

moderate, little concrete is needed and the top of the pipes or conduits need be not more than 12 to 15 in. below the surface of the soil. If traffic is heavy, it is necessary to lay the conduit deeper or to reinforce it sufficiently to carry the load in safety.

The National Electric Light Association recommends a minimum of 1½ in. separation between adjacent duct surfaces (to allow the concrete aggregate to pass through, and insure better heat dissipation) and about 3 in. thickness of concrete around the outside ducts.

Where several cables are carried in the same duct line, they must be suitably designed. The sketch shows how the capacity of cables is reduced as their number increases. These figures apply only to a certain type and size of cable, but the same principle holds good for all cables.

Cables Need Ventilation

For installations where there is little or no traffic above, asbestos conduit is available. It can be jointed the same as fiber conduit, but the space between the ducts can be filled with soil instead of concrete. This lowers the cost of installation and is quite satisfactory.

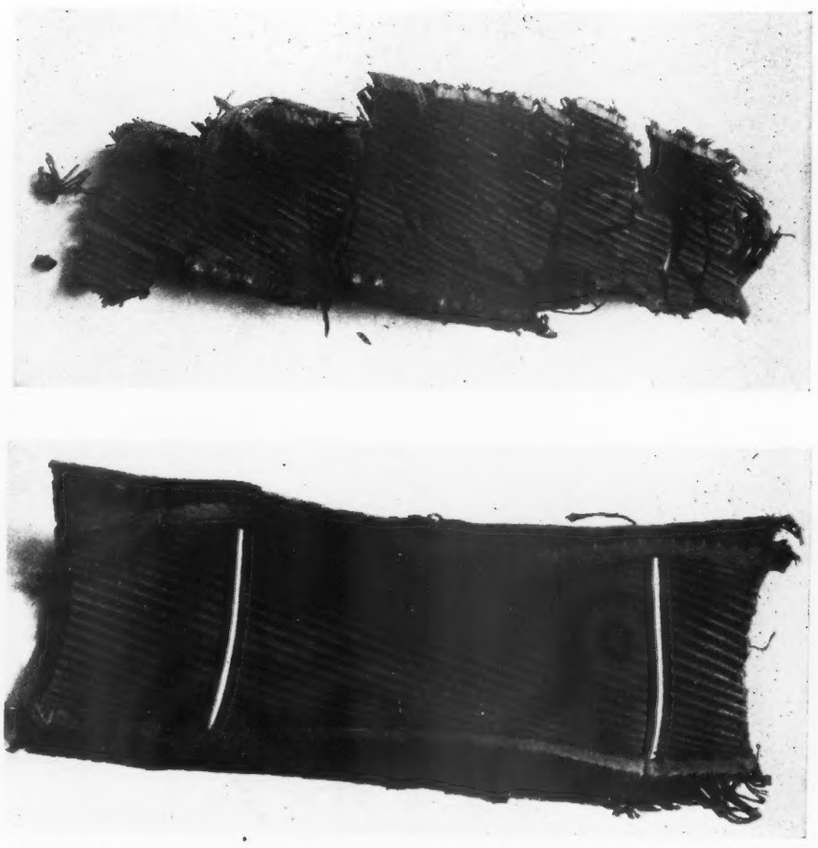
Either fiber or asbestos conduit is specifically suited for use when several conduits are run for reasonably long distances and contain few offsets or bends.

Manholes should be limited to convenient locations. The distances between them should be the maximum practical length of cable. This length varies with the cable, but usually runs from 200 to 500 ft. When manholes are required they should be at least 6 ft. in height, sufficiently roomy for two men to work in, and be properly drained and ventilated, particularly when work is being done in them.

For individual cable runs, or where offsets must be made, galvanized-iron conduits can be used and in many instances need not be incased in concrete. Recently, thin steel tubing has been used successfully. If and when it meets the requirements of the Code, it may be very economical.

Aluminum conduit of the same size as standard pipe is available for use under certain corrosive conditions. Copper alloy tubing also is used for similar situations.

Conduit is used mostly indoors, either in the open or laid in concrete as in floors, walls, foundations, and pads. It should always be installed with a slope so that it will drain throughout the run. Never use loops, and avoid vertical U-turns as much as possible. Trouble from deterioration of insulation due to condensation of moisture results from neglecting this precaution.



Effect of heat on the Code rubber insulation of a 500,000-circ.mil. cable after two years' service in a boilerhouse is shown in the upper illustration. The lower view indicates perfect condition of the insulation on a section of the same cable, outside the boilerhouse

When conduits carry control cables and other low-current circuits, they may be kept close together. Conduits that contain large cables carrying moderate or heavy currents should be spaced to allow for ventilation and heat dissipation sufficient to prevent mutual heating; otherwise the cable insulation, unless designed for high temperature, may be severely punished. The heavier the current, the more separation is needed. For example, three-conductor, 750,000-circ. mil, 2,300-volt cables in 4-in. conduits, carrying 425 amp. per conductor through a room at 40 deg. C. (104 deg. F.) ambient air temperature, should be spaced 12 in. apart, as calculated for an actual installation.

Where heavy cables are involved, more than the usual attention should be paid to conduit bends. Standard bends of steel conduits are hardly ever of sufficient radius for heavy cable because they were originally intended and designed for a large number of small wires, such as No. 14 and No. 12. For heavy cables the bends should be of considerably larger radius; otherwise trouble will be encountered in pulling the cable through.

As a rule, for conduit 1½ in. or more in diameter, standard pipe size, the radius of the bend should never be less than 24 in. If space conditions do not permit such large-radius bends, it is preferable to use pull boxes, rather than attempt to get along with standard bends.

For Heavy Loads, Bus

In preparing specifications for contractors it is necessary to specify in each case where large-radius bends should be used.

Where heavy-current circuits are required for either low or high voltage, it will be well to consider the use of bus instead of cables. It is

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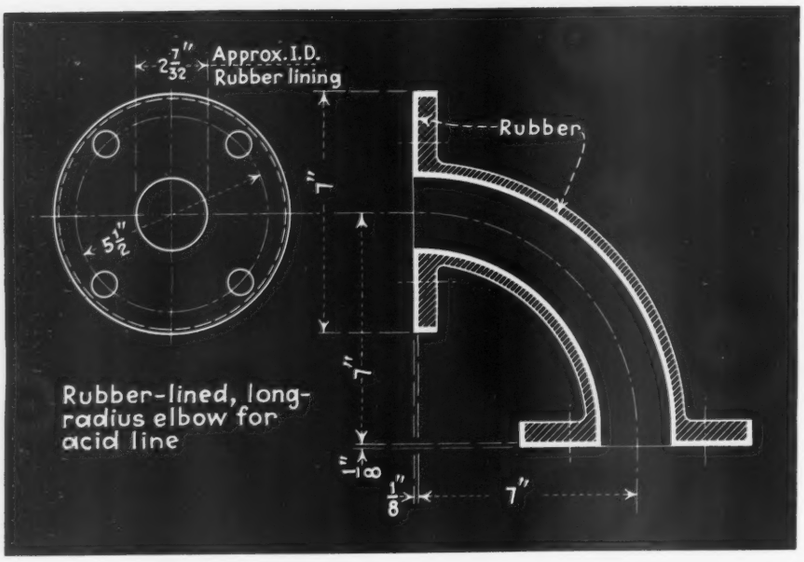

Rubber Is a Friend of Ours

As coating or lining or paint it protects metal parts from abrasion and acid attack

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UNUSUAL MAINTENANCE problems are encountered in keeping a glass plant in condition for 24-hr. operation. Nevertheless, when analyzed, they do not differ materially from those met in any manufacturing plant where large quantities of water and sand are handled, and where acid fumes are likely to play havoc. For example:

1. Large quantities of muriatic acid are used in cleaning the glass after it has been ground and polished. This acid is stored in two 5,000-gal. tanks and delivered by pipe line to the washer where it is used. The inside of the tanks is protected by a coating of cold-curing rubber compound.

The concrete upon which the tanks rest is coated with coal tar, which has been found to be the best material for protecting the concrete from the disintegrating effect of spilled acid.

2. Piping that leads from these tanks to the washer must also be protected from the action of the acid. This is done by vulcanizing a $\frac{3}{16}$-in. coating of rubber in each section of piping used. Since the acid must not come into contact with the galvanized pipe at any point, a complete layout must be planned with the length of each section indicated, since it is impossible to cut the pipe after it has been vulcanized.

In the vulcanizing process the rubber is brought up over the flanges to act as a gasket when the sections are put together at the point of use. This feature is shown in the accompanying illustration of a long-radius elbow. This vulcanized lining is used in pipe varying in diameter from $1\frac{1}{2}$ to 6 in. Piping so treated has been in continuous service for the past six years.

Similar protection is given to piping used in handling the sulphuric acid used in the rouge mix for polishing; rubber-protected valves prevent acid from coming in contact with metal surfaces.

3. Cold-drying rubber paint likewise finds many applications—for instance, in protecting the iron poles that carry the electric cable serving the motor in the dragline tower at the sand storage pile. A few months after these poles were erected it was found that sand particles, carried by the wind, threatened to cut them down. By coating them with rubber paint, this sandblast action has been completely eliminated.

Sand mixed with water and fed through hose to the grinding wheels presented another maintenance problem. Rubber paint again afforded the needed protection. When coated with it, oscillator hoppers feeding this mix to the hose leading to the grinding wheels likewise ceased to be a maintenance problem.

Stopcocks in the sand line are similarly treated, likewise the inside of boilers, water tanks, and stay rods inside water tanks.

4. Use of muriatic acid in cleaning glass after polishing, and sulphuric acid in the rouge used for polishing, means that some acid fumes are free to attack motor commutators, brush insulators, and brush-holders. This action formerly took place with the motors on the grinding and polishing heads, as well as on the nearby crane motors. Acid fumes would seep through between the mica sheets and attack the metal. It was also found that these fumes would find an opening through the $\frac{1}{4}$-in. insulation on the brush-holders, causing shorts and failures.

In the effort to remedy this condition, rosin was first tried. It was found, however, that after a short period the rosin would dry out and flake off. Commutator ends, brush insulators, and holders were thus again exposed to the old conditions of pitting and corrosion from the acid fumes. To prevent this flaking of the rosin, tallow was added. Now all commutator ends, brush insulators, and brush-holders are coated with a warm solution composed of one-third rosin and two-thirds tallow.

Some Oils Are More Oily

Of increasing importance as oil films become thinner, oiliness seems related to corrosiveness, and is affected by bearing composition

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PRECEDING ARTICLES in the April and July issues were concerned primarily with the lubrication of machinery capable of being "perfectly" lubricated. Such perfection does not necessarily imply the existence of the most economical or ideal conditions. In lubrication these terms signify merely a "perfect" separation of moving parts through the formation and retention, between these parts, of a complete and unbroken stratum of lubricant.

To what extent bearings in industry function perfectly in the above sense can be estimated only roughly. My guess is that about 80 per cent of all bearings in industrial use could be given perfect lubrication. At the same time, a very material percentage of industrial lubrication is not susceptible of perfection.

When Oiliness Is Important

In perfect lubrication, viscosity of the oil is by far the most important consideration. Nevertheless, other characteristics of lubricants possess significance, and under other than perfect conditions viscosity may become a minor matter.

Typically, conditions of low speed or heavy load represent problems of imperfect or so-called "boundary" lubrication. Nevertheless, oiliness may be an extremely desirable property of a high-speed lubricant. Even if a machine is perfectly lubricated during operation, it cannot be film-lubricated at the instant of starting. No oil film then exists, and except for "oiliness" no lubrication can be expected. Experience shows that starting wear may be the only thing that prevents almost indefinite life of bearings. Since reciprocating mechanisms are always under starting conditions, the necessity for oiliness in such cases is obvious.

In effect, perfect and boundary lubrication differ not in principle but in method. Ultimately all lubrication is solely a matter of separating surfaces. In perfect lubrication the separation is comparatively great. The thickness of the separating medium is appreciable, being at least some thousandths of an inch. In boundary lubrication, the film is very thin, even sub-microscopic.

For such extremely thin separating layers viscosity, if important at all, is most decidedly secondary. The most important consideration, presuming that a film has been formed, is an indefinite and elusive quality called oiliness. Its nature and mechanics are largely conjectural; its measurement and description can be accomplished solely in terms of its performance. If use of a boundary lubricant is accompanied by *relatively* low friction and wear, its oiliness is great. On the other hand, if the friction is relatively high, the oiliness is low.

Much confusing and contradictory literature exists on oiliness. Considerable research has been done on it but, generally speaking, the results are inconclusive. From it all these facts appear:

1. Oiliness is a term used to describe the tendency of an oil to provide lubrication, when the mechanism by which friction is reduced is largely unknown.

2. The most widely accepted theory of this unknown mechanism is that it comprises selective adsorption of constituents of the lubricant on one or both of the bearing elements. These adsorbable constituents are referred to as "polar compounds."

3. Oiliness seems to have little or no relationship to the conventional specifications and tests on lubricants; consequently these are not reliable criteria.

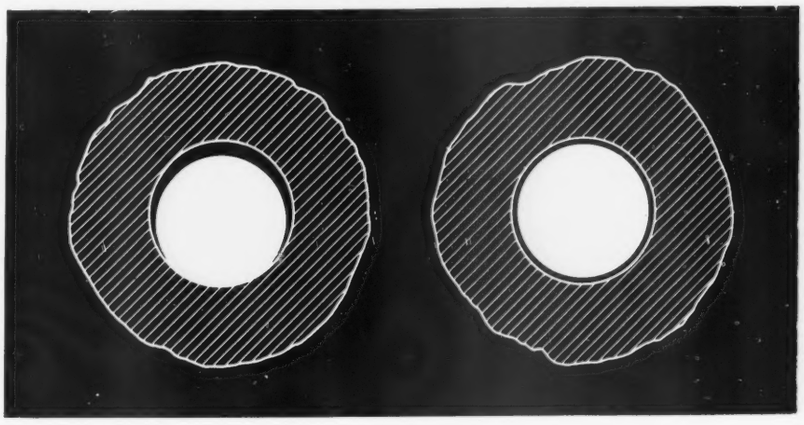
4. Present knowledge is insufficient to provide reliable laboratory methods to evaluate this quality, but enough to cast very grave doubts upon the validity of test methods so far proposed.

5. Oiliness in a lubricant is not dependent on the nature of the oil alone; the composition of the bearing materials is also a factor. A lubricant that possesses poor anti-friction qualities with one type of bearing material, may be excellent for bearings of identical shape but different composition.

6. There is one, and only one, standard of oiliness: Results when used on a specific machine, under specific conditions.

These statements probably will appear to be lacking in constructiveness. They are, however, the essence of our definite knowledge of the subject. Oiliness may not yet be assuredly based on specifications. The most that can be done by specifications is to duplicate as closely as

When a bearing is at rest, left, each start will wear or tear off a bit of metal, unless metal-to-metal contact is prevented by the oiliness of the lubricant. In operation, right, the parts of a properly lubricated bearing are separated by a continuous film of lubricant and no wear is possible



possible (purchasing always from the same source) an oil which has been found to be relatively satisfactory in practice.

Neither oiliness nor the lack of it appears to be an exclusive or consistent attribute of any class of oils. For one thing, as mentioned above, quality is not a function of the oil alone.

To be sure, certain types of oils possess the quality of oiliness under more broadly diversified circumstances than do other oils. Nevertheless, an appropriate correlation of lubricant type with operating conditions, including the composition of the bearings, is a prerequisite. A lubricant possessing great oiliness under one set of conditions may be inferior to another if the conditions are changed.

Less Refined—More Oily

Experience has shown, however, that on the average certain oil types are prospectively the more oily. After all, 90 per cent or more of industrial bearings are subject to limited variation in composition. The various babbitts, bronze, cadmium, copper-lead, iron, and steel cover a very high percentage of the field. Therefore it is possible to make a few worth-while generalizations:

The higher-priced, high-viscosity-index oils appear on the average to be distinctly less oily than do lower-priced oils of "inferior quality," so called without complete accuracy. This point will be discussed in greater detail in a succeeding article.

These latter oils are characterized by higher specific gravities (lower A.P.I. or Baumé gravities). Oils which have been altered in specific gravity by special refining methods usually follow this rule somewhat better than do more "natural" oils. Gravity changes in refining tend toward decreased density, and refining is destructive of oily substances. These facts lead to the generality that oils which have been subjected to a minimum amount of processing tend to give better service under high bearing pressures.

It would appear that polar compounds that became attached to the bearing surfaces come under the classification of what petroleum chemists have long regarded as impurities. Such compounds are presumably somewhat active chemically and in consequence are affected by chemical refining.

A third rule also correlative with the other two is: *Slightly* corrosive and comparatively unstable oils are characteristically oily. This fact is utilized to advantage in the manufacture of extreme-pressure lubricants, to which corrosive sulphur and/or chlorine are added.

To some extent the adherence of oily substances to metals may be physical, but there is almost incontrovertible evidence that much, possibly most, oiliness is a result of mild corrosive action. In other words, actual chemical union takes place between constituents of the lubricant and the surface of the bearing metal.

The prime utility of oiliness is to satisfy the first principle of lubrication: Separation of bearing surfaces. With high bearing pressures and boundary lubrication it may be less a question of reducing gradual wear, than one of avoiding sudden destruction by actual welding or seizure. Any material that prevents actual metal-to-metal contact, such as a layer of products resulting from corrosive action, may prevent seizure.

Corrosion Helps Lubrication

The ease with which bearings may weld together, resulting in anything from mild scoring to almost complete and immediate destruction, is not generally appreciated. Some idea of the mechanism involved and the ease with which the necessary conditions may be attained can be had from experiments where rubbing surfaces have been made to act as a thermal-couple junction. Surface temperatures in excess of 2,000 deg. F. have been indicated when a small cube of one bearing metal is placed on a piece of the other metal, inclined at an angle little more than that necessary to induce sliding. The temperatures of the sliding block itself may appear unchanged.

At the same time it is not always necessary that lubricants be used which are sufficiently corrosive to be a detectable factor in costs. The necessary degree of corrosiveness is roughly proportional to the greatest pressures mutually imposed upon each other by the bearing surfaces. For comparatively light service, straight "oily" petroleum oils may give as good results as are obtainable. So-called bright stocks and steam cylinder oils are representative of the more highly oily "natural" oils.

For more severe service, use may be made of a steam cylinder oil containing a small quantity of animal or vegetable oil, or oleic acid. For even worse conditions, resort may be had to the so-called extreme-pressure lubricants, containing chlorine and/or sulphur.

For the most extreme applications which have so far been reasonably well lubricated, an oil containing lead soap as well as sulphur is used, and appears to be the last resort.

From One Trouble to Another

It might appear that a very sensible way of insuring safe lubrication when conditions are known to be too severe for perfect lubrication, would be to take no chances and use the most oily substance available. On the other hand, the question is not solely one of preventing metal-to-metal seizure. It is one of judicial balancing of two factors: Wear by seizure and severe erosion *versus* wear by corrosion and mild erosion.

In the series of oily lubricants just enumerated there is a distinct progression toward increased wear from corrosiveness and secondary effects as the extreme-pressure characteristics of the lubricants increase. In addition there is a parallel progression of instability, decreased life, and increased cost of the lubricant.

In short, the more we ask of a lubricant in ability to meet trying conditions, the more we encounter difficulties of other nature. Arriving at the most economical lubricant becomes a procedure similar to that given in the article in the July issue for determining optimum viscosity. If a lubricant fails to prevent scoring and uneven wear, a slightly more oily, more corrosive, and more expensive lubricant should be tried. As soon as scoring is eliminated, no further increase in oiliness should be sought.

Lubricants made oily by artificial methods should usually be avoided on ball or roller bearings.

Probably the oldest of all oiliness agents is graphite, and it can often be a very fine one indeed. At the same time it is difficult to advise in a general way about its use. There are a large number of manufacturers of graphite lubricants possessing different characteristics and designed for different applications. Therefore, it is advisable to obtain the manufacturer's recommendations as to the material that should be used for a particular application.

(A succeeding article, to appear in an early issue, will discuss the significance and utility of lubricating oil specifications.—Ed.)

• Capacitor Kva. Required to Correct Load to Desired Power Factor •

USING THE MULTIPLIERS given in this table it is possible to determine by a very simple calculation the number of leading reactive kva. required to raise the power factor of any electrical load to any desired percentage. To do this it is merely necessary to ascertain the magnitude of the load in kilowatts, and the present power factor. Locate the present power factor in the left-hand column. Then locate on this line the multiplier given under the desired power factor. When the load in kilowatts is multiplied by this figure the result will be the reactive kva. required to raise the power factor to the desired value.

For example, assume that the wattmeter reads 100, the power factor is 60 per cent, and it is desired to raise it to 90 per cent. Locate 60, the present power factor, in the left-hand column. Reading horizontally to the right along this line, the factor 0.849 will be found in the column headed 90. Then, 100 kw. x 0.849 = 84.9 kva. Therefore, an 85-kva. capacitor will be required to raise the power factor of this load to 90 per cent.

Prepared by Cornell-Dubilier Corporation.

DESIRED POWER-FACTOR IN PERCENTAGE

ORIGINAL POWER-FACTOR IN PERCENTAGE

	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
40	1.537	1.564	1.591	1.616	1.644	1.668	1.694	1.773	1.747	1.777	1.805	1.832	1.861	1.895	1.924	1.959	1.998	2.037	2.085	2.146	2.288
41	1.474	1.501	1.527	1.553	1.581	1.605	1.631	1.659	1.684	1.713	1.742	1.769	1.798	1.831	1.860	1.896	1.935	1.973	2.021	2.082	2.225
42	1.413	1.440	1.467	1.492	1.520	1.544	1.571	1.599	1.623	1.653	1.681	1.709	1.738	1.771	1.800	1.836	1.874	1.913	1.961	2.022	2.164
43	1.356	1.383	1.409	1.435	1.463	1.487	1.513	1.541	1.566	1.596	1.624	1.651	1.680	1.713	1.742	1.778	1.816	1.855	1.903	1.964	2.107
44	1.290	1.317	1.344	1.369	1.397	1.421	1.447	1.476	1.500	1.529	1.558	1.585	1.614	1.647	1.677	1.712	1.751	1.790	1.837	1.899	2.041
45	1.230	1.264	1.290	1.316	1.341	1.360	1.394	1.422	1.447	1.476	1.501	1.532	1.561	1.592	1.626	1.659	1.695	1.737	1.784	1.846	1.988
46	1.179	1.205	1.231	1.267	1.282	1.309	1.335	1.363	1.388	1.417	1.446	1.473	1.502	1.533	1.567	1.600	1.636	1.677	1.725	1.786	1.929
47	1.130	1.157	1.183	1.209	1.234	1.260	1.287	1.315	1.340	1.369	1.397	1.425	1.454	1.485	1.519	1 552	1.588	1.629	1.677	1.758	1.881
48	1.076	1.102	1.128	1.154	1.179	1.206	1.232	1.260	1.285	1.314	1.343	1.370	1.400	1.430	1.464	1.497	1.534	1.575	1.623	1.684	1.826
49	1.030	1.058	1.084	1.110	1.135	1.160	1.188	1.216	1.241	1.270	1.297	1.326	1.355	1.386	1.420	1.453	1.489	1.530	1.578	1.639	1.782
50	.982	1.008	1.034	1.060	1.086	1.112	1.139	1.165	1.192	1.220	1.248	1.276	1.303	1.337	1.369	1.403	1.441	1.481	1.529	1.590	1.732
51	.936	.962	.988	1.014	1.040	1.066	1.093	1.119	1.146	1.174	1.202	1.230	1.257	1.291	1.323	1.357	1.395	1.435	1.483	1.544	1.686
52	.894	.920	.946	.972	.998	1.024	1.051	1.077	1.104	1.132	1.160	1.188	1.215	1.249	1.281	1.315	1.353	1.393	1.441	1.502	1.644
53	.850	.876	.902	.928	.954	.980	1.007	1.033	1.060	1.088	1.116	1.144	1.171	1.205	1.237	1,271	1.309	1.349	1.397	1 458	1.600
54	.809	.835	.861	887	.913	.939	.966	.992	1.019	1.047	1.075	1.103	1.130	1.164	1.196	1.230	1.268	1.308	1 356	1.417	1 559
55	.769	.795	.821	.847	.873	.899	.926	.952	.979	1.007	1.035	1.063	1.090	1.124	1.156	1.190	1.228	1.268	1.316	1.377	1.519
56	.730	.756	.782	.808	.834	.860	.887	.913	940	.968	.996	1.024	1.051	1.085	1.117	1.151	1.189	1.229	1.277	1.338	1.480
57	.692	.718	.744	770	.796	.822	.849	.875	.902	.930	.958	.986	1.013	1.047	1.079	1.113	1.151	1.191	1.239	1.300	1.442
58	.655	.681	.707	.733	.759	.785	.812	.838	.865	.893	.921	.949	.978	1.010	1.042	1.076	1.114	1.154	1.202	1.263	1.405
59	.618	.644	.670	.696	.722	.748	.775	.801	.828	.856	.884	.912	.939	.973	1.005	1.039	1.077	1.117	1.165	1.226	1 368
60	.584	.610	.636	.662	.688	.714	.741	.767	794	.822	.849	.878	.905	.939	.971	1.005	1.043	1.083	1.131	1.192	1.334
61	.549	.575	.601	.627	.653	.679	.706	.732	.759	.787	.815	.843	.870	.904	.936	.970	1.008	1.048	1.096	1.157	1.299
62	.515	.541	.567	.593	.619	.645	672	.698	725	.753	781	.809	.836	.870	.902	.936	.974	1.014	1.062	1.123	1.265
63	.483	.509	.535	.561	.587	.613	.640	.666	.693	.721	.749	.777	.804	.838	.870	.904	.942	.982	1.030	1.091	1.233
64	.450	.476	.502	.528	.554	.580	.607	.633	.660	.688	.716	.744	.771	.805	.837	.871	.909	.949	.997	1.058	1.200
65	.419	.445	.471	.497	.523	.549	.576	.602	.629	.657	.685	.713	.740	.774	.806	.840	.878	.918	.966	1.027	1.169
66	.388	.414	.440	.466	.492	518	.545	.571	.598	.626	.554	.682	.709	.743	.775	.809	.847	.887	.935	.996	1.138
67	.358	.384	.410	.436	.462	.488	.515	.541	.568	.596	.624	.652	.679	.713	.745	.779	.817	.857	.905	.966	1.108
68	.329	.355	.381	.407	.433	.459	.486	.512	.539	.567	.595	.623	.650	.684	.716	.750	.788	.828	.876	.937	1.079
69	.209	.325	.351	.377	.403	.429	.456	.482	.509	.537	.565	.593	.620	.654	.686	.720	.758	.798	.840	.907	1.049
70	.270	.296	.322	.348	.374	.400	.427	.453	.480	.508	.536	.564	.591	.625	.657	691	.729	.769	.811	.878	1.020
71	.242	.268	.294	.320	.346	.372	.399	.425	.452	.480	.508	.536	.563	.597	.629	.663	.701	.741	.783	.850	.992
72	.213	.239	.265	.291	.317	.343	.370	.396	.423	.451	.479	.507	.534	.568	.600	634	.672	.712	.754	.821	.963
73	.186	.212	.238	.264	.290	.316	.343	.369	.396	.424	.452	.480	.507	.541	.573	.607	.645	.685	.727	.794	.936
74	.159	.185	.211	.237	.263	.289	.316	.342	.369	.397	.425	.453	.480	.514	.546	.580	.618	.658	.700	.767	.909
75	.132	.158	.184	.210	.236	.262	.289	.315	.342	.370	398	.426	.453	.487	.519	.553	.591	.631	.673	.740	.882
76	.105	.131	.157	.183	.209	.235	.262	.288	.315	.343	.371	.399	.426	.460	.492	.526	.564	.604	.652	.713	.855
77	.079	.105	.131	.157	.183	.209	.236	.262	.289	.317	.345	.373	.400	.434	.466	.500	.538	.578	.620	.687	.829
78	.053	.079	.105	.131	.157	.183	.210	.236	.263	.291	.319	.347	.374	.408	440	.474	.512	.552	.594	.661	.803
79	.026	.052	.078	.104	.130	.156	.183	.209	.236	.264	.292	.320	.347	.381	.413	.447	.485	.525	.567	.634	.776
80	.000	.026	.052	.078	.104	.130	.157	.183	.210	.238	.266	.294	.321	.355	.387	.421	.459	.499	.541	.608	.750
81	—	.000	.026	.052	.078	.104	.131	.157	.184	.212	.240	.268	.295	.329	.361	.395	.433	.473	.515	.582	.724
82	—	—	.000	026	.052	.078	.105	.131	.158	.186	.214	.242	.269	.303	.335	.369	.407	.447	.489	.556	.698
83	—	—	—	.000	.026	.052	.079	.105	.132	.160	.188	.216	.243	.277	.309	.343	.381	.421	.463	.530	.672
84	—	—	—	—	.000	.026	.053	.079	.106	.134	162	.190	.217	.251	.283	.317	.355	.395	.437	.504	.645
85	—	—	—	—	—	.000	.027	.053	.080	.108	136	.164	.191	.225	.257	.291	.329	.369	.417	.478	.620

Operation of Centrifugal Pumps

1. Never start pump until the casing is full of liquid. Internal parts depend on liquid for lubrication.

2. Always start pump with discharge valve closed. This will save wear and tear on the prime mover.

3. Do not run pump for too long a time with discharge valve closed. Churning action of the impeller generates heat, and seizure or distortion of parts may result. Therefore, do not run pump when air- or vapor-bound.

4. Do not tighten packing excessively. A scored shaft or serious overheating may result. Slight leakage around shaft serves as a lubricant and is desirable.

5. Never throttle pump with the suction valve.

6. Always protect pump with a check valve in the discharge side. Failure to provide a check valve here may result in damage to the pump from water hammer or reversal of flow.

7. Never run a pump in the wrong direction. Parts may become loose and be damaged.

8. Select packing with care. Too-hard packing will score shaft. Packing not suited to the liquid handled will necessitate frequent replacement, and always be a source of trouble.

9. Inspect pump packing and oil level in bearings frequently. If there is leakage into oil reservoirs of bearings, drain and refill with fresh oil.

TROUBLES

Symptom	*Cause*	
Failure to deliver water	1. Pump not primed. 2. Obstruction in suction or discharge line. a. Valve closed. b. Suction strainer plugged. c. Suction foot valve stuck in closed position. 3. Wrong direction of rotation. 4. Speed too low. a. If motor driven, check speed and line voltage. b. If turbine driven, check governor setting and initial and exhaust steam pressures. c. If driven from lineshaft, check shaft speed and pulley sizes. 5. Impeller plugged up. 6. Suction lift too high, with cold liquids. 7. Suction head too low when pumping hot or volatile liquids. 8. Discharge head too high. Check both suction and discharge head with gages.	
Too-low pressure or quantity of liquid discharged	9. Suction or discharge piping and strainers partially stopped up. (See item *2*) 10. Air leaks in suction line. 11. Air leaks in stuffing boxes. 12. Speed too low. (See item *4*) 13. Suction lift too high. 14. Suction head too low when pumping hot or volatile liquids. 15. Discharge head too high. 16. Impeller partially plugged up.	17. Impeller damaged. 18. Wearing rings badly worn, giving excessive clearance. 19. Foot valve too small, or insufficiently submerged. 20. Packing in casing or stage joints defective, allowing water to bypass from discharge to suction. 21. Wrong impeller in pump. Check diameter and clearances. 22. Air or gases in liquid handled
Pump fails, after operating satisfactorily	23. Water seal plugged. (Check items *1*, *2*, *5*, *6*, *7*, *19*, and *22*.)	
Power consumption too high	24. Speed too high. 25. Head lower than designed for. 26. Density of liquid greater than water.	27. Bent shaft. 28. Rotating element binds; check thrust and balancing devices. 29. Stuffing boxes too tight. See *18*, *20*.
Excessive vibration	30. Misalignment. When either pump or driver becomes hot during operation, check alignment under operating conditions. 31. Foundation not sufficiently rigid.	32. Impeller partially clogged, causing unbalance. 33. Worn bearings. 34. Casing distorted. See items *27* and *28*.
Too much leakage around shaft	35. Insufficient packing. 36. Packing sleeves on shaft worn.	37. Too much sealing water.
Water in bearings	38. Stuffing box leakage excessive. 39. Stuffing box drains plugged.	40. Leakage between shaft and packing sleeves.
Excessive internal wear of pump	41. Cavitation from air or gases in liquid. 42. Abrasion caused by solid particles.	43. Corrosive action of liquid handled. (When renewing, use metals resistant to these conditions.)

Prepared by S. H. COLEMAN, *Roanoke, Va.*

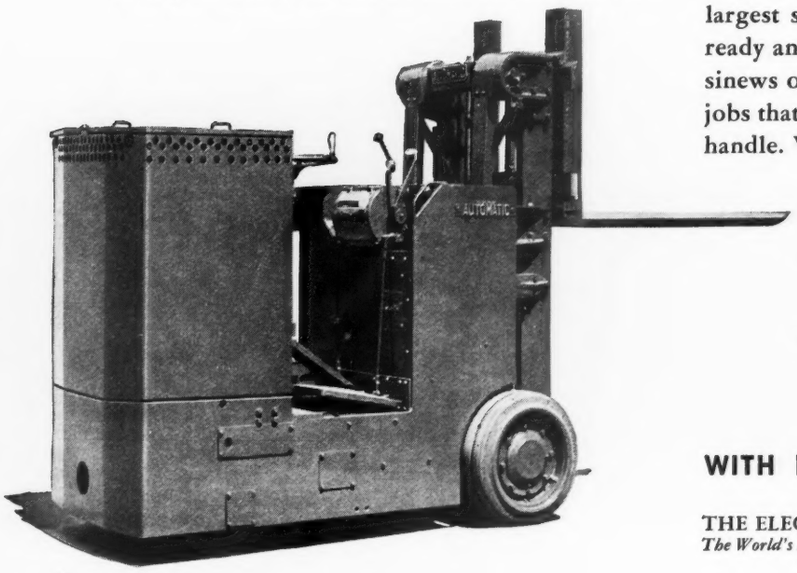
Exide announces a SUPER BATTERY

Largest size industrial truck battery ever made

LARGER, more powerful material handling trucks . . . industry has wanted them, needed them. Now they are possible, for here is a battery to drive them that has nearly twice the capacity of former electric industrial truck batteries.

The new *super* Exide-Ironclad, Type FLM-13, has a capacity of 1080 ampere-hours at the normal six hour discharge rate. Yet it requires but 26" x 51" floor space, for it is assembled in a space-saving steel tray. In double-shift service, the steel tray assembly facilitates quick changing of batteries, providing continuous service through the use of duplicate batteries.

With the big trucks of today, and the larger ones planned for tomorrow, this super Exide-Ironclad Battery enormously broadens the useful range of low-cost handling methods. It is the world's largest size battery for electric industrial trucks, ready and able to pour giant power into the steel sinews of these units—the battery for those heavy jobs that some men thought no battery could ever handle. Why not write for full details today?



Exide
IRONCLAD BATTERIES
WITH EXIDE MIPOR SEPARATORS

"MIPOR," Reg. U. S. Pat. Off.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

You want to know

and the editors will gladly tell you more about the things mentioned on this page

• ALUMINUM PAINT—read all about it in a 102-page manual which covers such things as the paint's characteristics, pigments, vehicles, testing, methods of application. (11701)

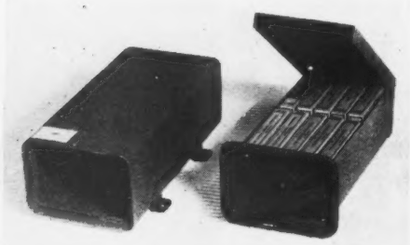
• PLANTS can now make their own cemented carbide-tipped tools, thanks to a booklet prepared by a manufacturer of these tools. It describes the process by which the work should be done, using his product. (11702)

• THREAD-CUTTING SCREW cuts its own thread in metals and plastics of practically any thickness. Should it ever be necessary to remove it, an ordinary machine screw of the same size will fit its threads. (11703)

• SOLDER of high tensile strength can be used on such difficult-to-solder metals as aluminum, cast iron, die cast metal, stainless steel, and monel. A low-temperature solder, it melts at 500 deg. F. (11704)

• COFFEE DISPENSER for plant lunchrooms holds pint bottles of a special coffee concentrate. Valve mechanism in neck of the dispenser delivers measured teaspoon of concentrate each time dispenser is tipped. (11705)

• STRAINS AND DEFECTS in transparent materials can be instantly detected by a polarizer and analyzer which attaches to any microscope. Opaque materials can be tested, too, by taking very thin sections for test specimens. (11706)



FIRST AID KIT for wall mounting has inner case that can be withdrawn and carried to scene of the accident. Contained in it are ten units of dressings and treatments selected to meet user's needs. Units are complete in themselves for single use; there is no waste of material, and danger of infection is minimized. (11727)

• 1937 EDITION of the "Manual of Smoke and Boiler Ordinances and Requirements," prepared in the interest of smoke prevention, air pollution regulation, and fuel conservation, has just been published. (11707)

• COLORED METALS are the latest. Prefinished in yellow, red, blue, or green, in crimped, scored, and striped patterns, they can be formed without harm to the finish. (11708)

• THE PLASTICS INDUSTRY has had a rapid rise and its developments are difficult to keep up with. To help in this respect is a yearbook and directory, just out, which covers all phases of the field. (11709)

• RUST SOLVENT is a semi-paste material applied by brush on metal surfaces. Comes in containers of from 1 to 50 gal. (11710)

• STENCIL has locking edges on individual letters and numbers so that any desired assembly can be made. Letters come in ½- to 6-in. sizes in single sets or fonts. (11711)

• PRIMER for use on metal products air dries out of dust in 5 min. Applied by dipping or spraying, it is suitable for use under air dryng lacquer enamels or baking synthetic enamels, or as a shop coat. (11712)

• DEGREASING FLUID is mixed with water or kerosene to dissolve oil or grease so that they can be removed by a stream of cold water. Applied by spraying or brushing. (11713)

• CONDENSATION on pipes and other metal surfaces can be prevented by covering them with mixture of red lead and cork, it is reported. (11714)

• IF lack of electrical outlets is a problem, you'll want to look into a new continuous outlet system which consists of a metal raceway mounting on baseboard or set flush in cement or plaster. Knockouts for standard receptacles can be made at any point, for cable or ½-in. conduit every 8 in. (11715)

• SURFACING MATERIAL for floors provides a slip-proof surface in dry or wet locations. It's waterproof, dark red in color, can be applied on wood, concrete, or steel. (11716)

• WEATHERSTRIPPING is made of rubber and designed to be used on metal casement and pivoted windows.

TWO OR THREE squeezes of the trigger on this belt dressing applicator eject enough dressing for the average belt. Because it can be used some distance from moving units, it makes dressing a safer operation. (11726)

Semi-plastic, it conforms to all irregularities and cold vulcanizes in position. (11717)

• TIME STAMP suitable for job time and employee attendance work has imprints so condensed they will go into margins of a letter. (11718)

• SETSCREW locks itself into the tapped hole by means of two knurled threads which back up against the threads of the tapped hole. A hollow-type screw, it works equally well in steel, cast iron, and brass. (11719)

• TILE, a composition of asbestos fiber and Portland cement, can be applied on large areas, and serves admirably for skeleton frame buildings. Strong, fire- and weather-resistant, it has a natural gray color, needs no protective coating. (11720)

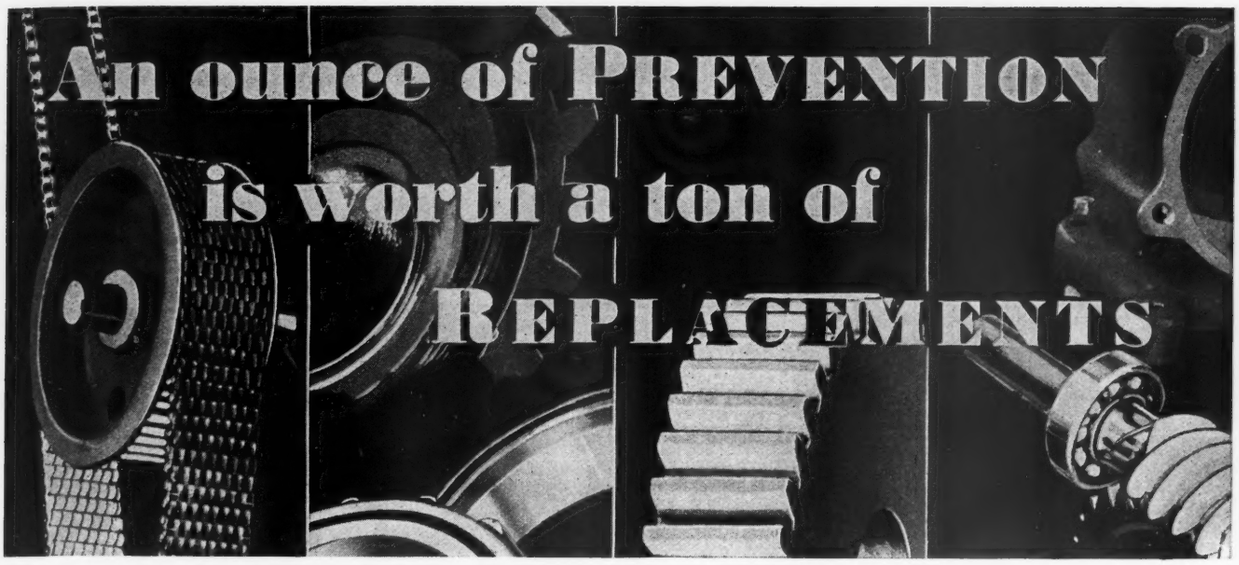
• MICROSCOPE, pocket size, is capable of 40 magnifications. For inspectors checking quality of surface finishes, or trying to determine extent of wear, it should be useful. (11721)

• THERMOMETER, all-metal and non-breakable, floats in hot liquids and takes their temperatures. Ball-shaped, it has a scale engraved on the outside, bimetallic mechanism inside. (11722)

• ADHESIVE for waterproofed material is made by adding a new solution to flour paste. It can be used on porous material too. (11723)

• STOP WATCH and revolution counter are combined in one unit. When point of plunger is pressed against revolving shaft, counter and watch start simultaneously. One turn of knob rewinds watch, resets counter. (11724)

• RESIN is said to produce enamel vehicles comparable to China wood oil. With the Chinese-Japanese war on, it should find application as a substitute for the Chinese product. (11725)



LUBRIPLATE

lubricants speed up production machines —and lower operating costs.

For many years the subject of lubrication received only scant attention but with the advent of improved steels and modern machining methods, loads and speeds were stepped up to a point where the old time lubricants just would not do the job. So along came LUBRIPLATE, "The Modern Lubricant," and what a grand job it has done in reducing friction and wear with consequent reduction in power and upkeep costs.

●

Every saving on plant maintenance costs helps the profit sheet. Today more than ever, maintenance engineers—having pared routine charges to the bone—are seeking still further reductions in upkeep. And in this picture LUBRIPLATE, offering an entirely new method of lubrication, takes a particularly prominent place. Because LUBRIPLATE of all lubricants now on the market, will reduce to a new low, dozens of items of plant maintenance and machine operation.

●

LUBRIPLATE definitely reduces wear and friction, lowers power costs and decreases high-speed operating temperatures. LUBRIPLATE prolongs the life of machinery to an infinitely greater degree than any other lubricant on the market. These facts are daily being demonstrated in dozens of leading industrial establishments.

●

Friction is the thief who is lurking, unseen, in every place in your plant where there are moving machine parts. You can't see him. You can only see the damage he does and add up the dollars he takes from you after it's too late to do anything but pay. LUBRIPLATE is certainly the most deadly enemy of this thief called friction.

"It's the Film"

WRITE US TODAY

LUBRIPLATE DIVISION

FISKE BROTHERS REFINING CO.

Established 1870

129 LOCKWOOD ST., NEWARK, N. J.

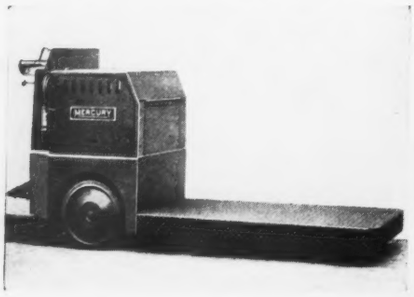
Plants: NEWARK, N. J. and TOLEDO, OHIO

DEALERS FROM COAST TO COAST

What's New in Equipment

Truck

Model A-1015-1 low-platform truck has capacity of 4,000 lb. and platform dimensions of 72 in. long, 41 in. wide, 11 in. high. A 6,000-lb. model is also available. Drive wheels are solid rubber tired, size 20x5, and trailing wheels are solid rubber tired, size 10½x5. Drive axle is double-reduction spiral-bevel and spur-gear type with external, contracting-type brake mechanism. Four-wheel steering. Mercury Mfg. Co., 4118 South Halsted St., Chicago.



Controller

Model 4038 throttling potentiometer controller provides close temperature regulation for heat treating furnaces and similar applications. Controls throttling valve to control fuel flow and hold temperature constant within throttling range. Operates on familiar potentiometer-pyrometer circuit, but utilizes a second slide wire in the control circuit for smooth operation. Said to be particularly suitable for precise regulation of furnaces operating under fairly uniform conditions of loading, fuel pressure, B.t.u. value, and the like, where a definite furnace temperature may be expected for each position of valve opening. The Foxboro Co., Foxboro, Mass.

Liquid Handling

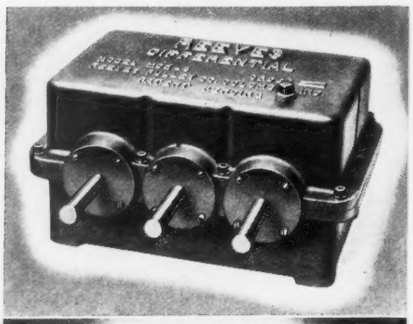
Direct-pressure "Liquivator" is a unit for automatically transporting liquids by means of the displacement principle. Consists of a stationary pressure tank to which an operating valve mechanism is externally connected. Counterweighted displacement tank within the pressure tank provides power for valve control through simple leverage. Available in both metering and non-metering types. Either type can be furnished in self-contained or remote-control assembly. Morehead Mfg. Co., Detroit.

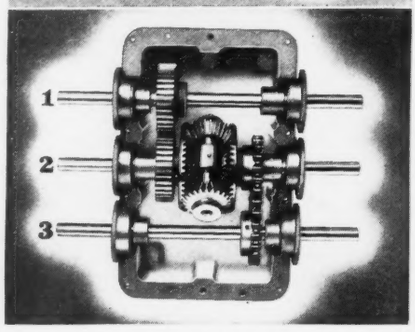
Electrode Holder

Model B-4 welding electrode holder features light-weight and high conductivity. Made of Mallory 3 metal. Ventilated handle insulation; fiber-insulated upper tong and compression spring. Has 20-amp. capacity; takes rods 1/16 to 3/16 in. Jackson Electrode Holder Co., Detroit.

Speed Control

Model MDB-3 differential control is designed to be used as accessory equipment to the company's variable-speed transmission. Within a unit housing are mounted three parallel shafts operating in a bath of oil. Gears of 1:1 ratio drive between shaft 1 and the differential gearing. Between shaft 3 and the differential gearing is a 1:1 chain drive. Special ratios are also available. For automatic control service, shafts 1 and 3 are connected to the driven machine or machines and shaft 2 is connected to the speed-changing screw of the transmission. The differential may also be used as primary driving equipment for loads not exceeding its rated torque and





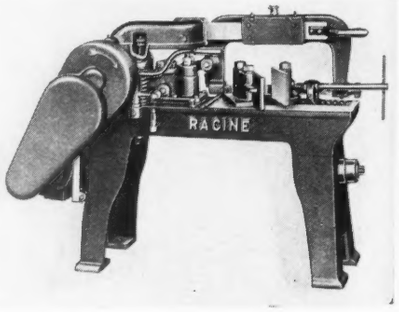
speed capacity. Infinite range of speed variations possible by connecting shafts 1 and 3 to constant and variable-speed shafts, respectively, of the transmission. By turning speed control handwheel on transmission, shaft 2 may be adjusted to any speed in either direction. Dimensions of the unit are 11x8x6⅝ in. Reeves Pulley Co., Columbus, Ind.

Indicator

Model One test indicator is graduated to read in 0.001 in., with range of 0.030 in. It can also be furnished in metric graduations. It can be used in surface or height gages or in toolposts. Federal Products Corp., 1144 Eddy St., Providence, R. I.

Power Saw

Hydraulic-feed sawing machines are built in dry- and wet-cut types. The wet-cut runs at higher speed, has larger motor, cabinet base, coolant system, and two-speed transmission (three-speed also available), otherwise the two are of the same design. All hydraulic functions are built into one compact unit. Motor drives through V-belt to intermediate ball bearing-mounted pinion, thence by direct gear drive to main shaft of machine. Automatic lift on non-cutting stroke raises teeth above



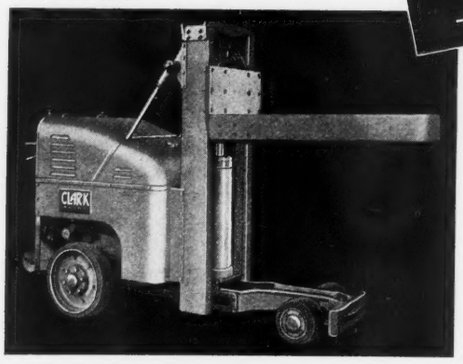
"Clarktor-6" Industrial Tractor—Six-cylinder engine. Drawbar pull, up to 3400 lbs.

Clark 3-ton "Truclift"—rear-wheel drive, 4-wheel steer. Self starter, generator, battery.

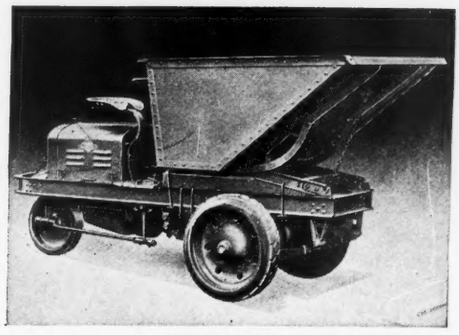
Direct Gas Powered

—always. Since 1917

Clark 3-ton "Tructier"—lifts 11 in. to 54 in. in 15 sec. Speed 1 to 9 m.p.h.



Clark 3-ton Finger Tilting Telescopic "Tructier"—lifts 6,000 lbs. to 97¾ in.



Clark 2-ton "Tructractor"—automatic dump body with 40 cu. ft. capacity.

"Clarkat"—pulls 25-ton loads on trailers—turns around in a box car.

CLARKS help you meet production quotas

There are over 50 models of Clark lifting, carrying, tiering, pushing and pulling machines for keeping things moving—raw materials, parts, finished product, waste. Clarks help speed production in these days when quotas are high. They're economical to operate, easy to service. Tell us about your haulage problem—let our engineers suggest a solution.

CLARK TRUCTRACTOR

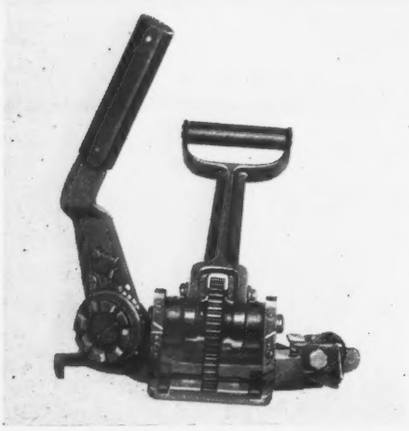
Div. of Clark Equipment Company

BATTLE CREEK, MICHIGAN

work. Swivel vise makes it possible to cut 3-in. stock at 45 deg. Length gage for cutting multiple pieces. Automatic knockout trips clutch at completion of cut. Racine Tool & Machine Co., Racine, Wis.

Wire-Strapping Machine

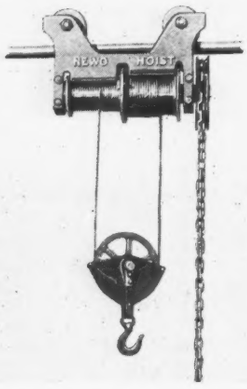
Model N wire-strapping or tying machine can be used as shipping reinforcement or it can be applied in baling and bundling cartons and cases. After wire is inserted through machine and draped around box to be strapped, the tension handle at left is operated back and forth



until required tension is obtained. One complete stroke of the center operating handle follows, twisting wire and forming seal. At the same time, the wire is cut and all parts automatically return to their original positions. The Gerrard Co., Inc., 2915 West 47th St., Chicago.

Hoist

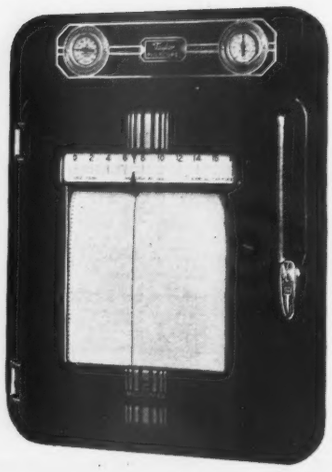
Hoist will handle loads not exceeding 500 lb. Although gearless, it has lifting ratio of approximately 15 to 1, obtained by winding cable on large drum as smaller drum unwinds. Power is obtained by means of sprocket and endless chain. Latch



acts as ratchet while load is raised. It is disengaged in lowering, instantly engaging when released and stopping downward movement. Hoist travels on 1½-in. double-strength pipe or on I-beam. Newo Hoist Co., 17309 Fernway Rd., Cleveland.

Controller

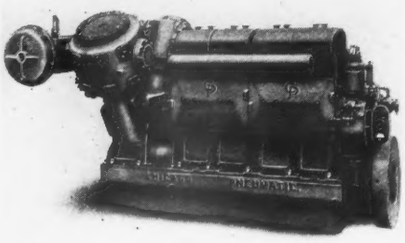
"Fulscope Micromax Controller" is an air-operated potentiometer controller for operation in conjunction with the com-



pany's "Motosteel Diaphragm Valve." Temperature-measuring system is the Micromax recording and indicating potentiometer which is fully automatic. Manufacturer states that its use lies in process control where smooth, proportional valve action is imperative. Taylor Instrument Cos., Rochester, N. Y.

Compressor

Class W-CO compressor consists of a vertical, 4-cylinder, 4-cycle, medium-speed diesel engine on a common crankcase and crankshaft with a V-type, 2-stage, double-acting, water-cooled compressor. Built in sizes having 3 or 4 engine cylinders, rated 112½ and 150 hp. respectively, with 2-stage compressor cylinders having piston dis-



placements of 655 and 830 cu. ft. per min. respectively, for a discharge pressure of 100 lb. per sq. in. at sea level. The engine is started by compressed air, a small gasoline engine-driven air-starting equipment being included in the standard equipment. Chicago Pneumatic Tool Co., 6 East 44th St., New York.

Oil Filter

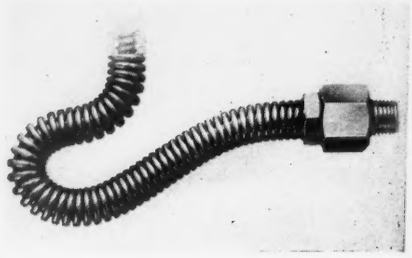
"Stream-Line" filters oil through packs of specially treated paper disks held by spring pressure. Separated impurities are left on outer edges from which they are cleaned by air pressure applied back through the unit. Skinner Purifiers Inc., 2331 Dalzelle St., Detroit.

Aluminum Paint

"High Temperature" aluminum paint is said not to color, crack, peel, or blister at temperatures up to 1,000 deg. F. Dries quickly. Fisher Scientific Co., Forbes St., Pittsburgh.

Seamless Tubing

"T.S.T. Triple Safe Tubing" is a flexible metal hose having the metal braid embedded between two corrugated seamless tubes, forming an all-metal, weldless, jointless, and packless metal hose. Can be cut with a hacksaw like ordinary pipe, and fittings attached. Made of bronze alloy, and to order in aluminum. Standard sizes are ¼, 5/16, ⅜, and ½ in. inside diameter. Seamlex Co., 5-19 48th Ave., Long Island City, N. Y.



Protective Coating

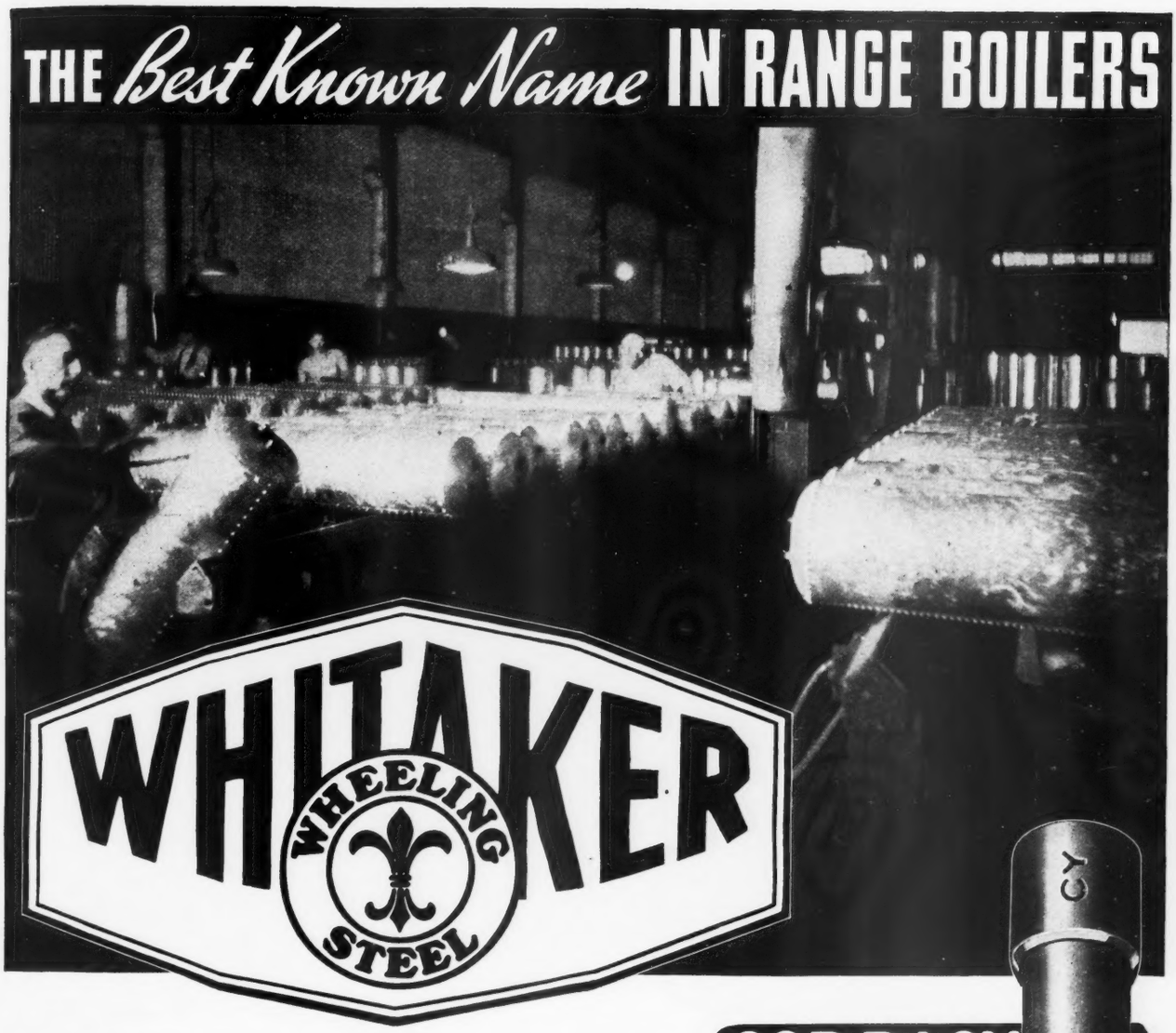
"Black Metal Wrap" is a liquid material for application by spraying, dipping, or brushing on metal surfaces to protect them during storage and handling. It can be used on base metal, chromium-plated or lacquered parts. Removed by washing with solvents such as gasoline, naphtha, and kerosene. Wayne Chemical Products Co., Copeland St., Detroit.

Pump

"Sure Flow" centrifugal pump is self-priming and instant flowing. It is not necessary to submerge any part of the pump in the liquid and no foot or check

valves are required in the intake line. The pump may be located at any convenient point near the operation, with the tank also located conveniently. Will handle practically any type of liquid. There are no metal-to-metal contacts and bearing surfaces are protected by rotary seals. It can safely pump liquids charged with abrasives, filings, most corrosive impurities, and even solids within reasonable limits. Available in nine models, ranging in capacity from 4

THE *Best Known Name* IN RANGE BOILERS



Whitaker gives you automatic arc welding of all seams for uniform penetration the full length of the weld. Side seams are rolled to reduce porosity. Head and bottom material is sufficiently thick that openings may be swaged or extruded from the base metal. Perfect drainage and freedom from sediment accumulation is assured by the Whitaker Patented Star Bottoms. And a specially compounded coating of pure zinc is applied by Wheeling's hot-dip process on a base of COP-R-LOY for extra durability and better appearance. *Sold only through recognized jobbers* of plumbing and heating supplies. Specify Whitaker in ordering from your jobber . . . *It's Wheeling Steel.* Wheeling Steel Corporation, Wheeling, West Virginia.

COP-R-LOY
Reg. U. S. Pat. Off.

Your distributor can supply you with COP-R-LOY *Pipe . . . black and galvanized, made of Wheeling's famous copper alloyed steel for long dependable service*

IT'S WHEELING STEEL

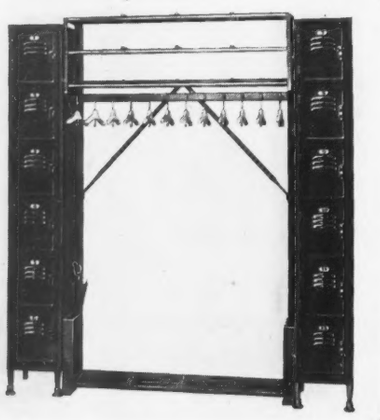
to 150 gal. per min. Offered with direct motor power, belt drive, or adapter for direct power take-off. Logansport Machine, Inc., Logansport, Ind.

Air-Gas Regulator

Type 2-100 oil-operated, air-gas regulator is applicable to problems requiring control of ratio between pressures or differentials such as blast furnace gas burner control, air-fuel-ratio control, gas-mixing control, and boiler-combustion control. Has indicator and handwheel by means of which ratio of controlled to leading pressure or differential is adjustable. Hagan Corp., Pittsburgh.

Coat Rack

Combination wardrobe and locker unit accommodates 12 coats, 12 hats, 18 umbrellas, shelf for overshoes, and 12 locker compartments each 12x12x12 in. Occupies only 6 sq. ft. Unit is flexible as to size, can be had in any length. It comes by the foot and accommodates 3 persons per running foot. Fixed spacing of coat hangers, hat shelves ventilated and individually divided, individual umbrella compartments. Vogel-Peterson Co., Inc., 1801 North Lincoln St., Chicago.



Fire Hose

New hose is said to be 18 per cent lighter than ordinary type, yet equal in capacity and bursting strength. Jacket is woven from special, flexible, whip-lash-type cord. Life of the hose is said to be increased by special flat-curing process. Further protection against deterioration is assured by saturation of the cotton in the hose with a mildew- and moisture-proof composition which also prevents the hose from freezing to the ground in cold weather. The B. F. Goodrich Co., Akron, Ohio.

Gas Masks

Full-vision gas masks have wide lenses which permit wearer to see, read, work, walk, and observe surroundings in safety. Lenses are made of shatterproof, laminated, polished plate glass and afford 90-deg. vertical and 170-deg. lateral vision. These canister masks are available in both corrugated-tube and snout types. The light-weight, all-rubber facepiece is molded and cured to face-fitting proportions. Head hardness connections are located in such a way as to eliminate all forehead pressure points, permitting wearing of hat or helmet without discomfort. To eliminate build-up of used air in the fresh air ducts, there are one-way flap valve ends on the fresh air ducts which close upon exhalation. Available with a choice of elastic, all rubber, or permanent non-rubber head hardnesses and a wide selection of canisters covering organic vapors, acid gases, ammonia and industrial smokes. Acme Protection Equipment Co., 2601 Koppers Bldg., Pittsburgh.

Enamel

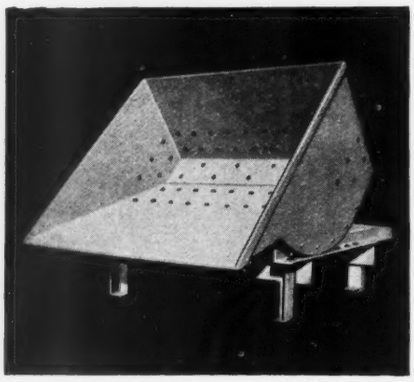
Black enamel dries to a rubber finish, is said to be tough and to have high electrical resistance. Suitable for finishing electrical apparatus such as switchboards and instrument panels. Applied by spraying. Also available in a surfacer with similar properties for preparing the surface to be finished with this enamel. Maas & Waldstein Co., 420 Lexington Ave., New York.

Chain Wrench

No. 864 all-purpose chain wrench is designed to handle any shape nut, pipe, or rod. Is especially designed for operations in confined quarters where large, long-leverage wrenches are useless. Capacity of 1½ to 4½ in. Has 16-in. flexible chain that will withstand pressure of 3,200 lb. Handle is 12 in. long. The Herbrand Corp, Fremont, Ohio.

Dump Hopper

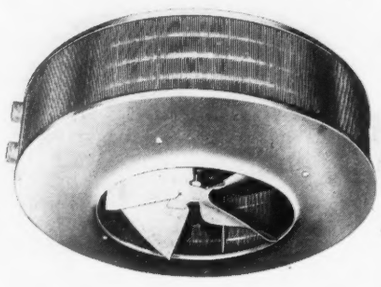
Dump hopper for use with hand or power lift trucks is designed especially for service where equipment is subjected to high heats. Arranged for side dump; also furnished for end dumping. Fabricated



of alloy steel with sides and bottom perforated. Has 1-yd. capacity and is furnished on legs or casters with any specified underclearance. Equipped with simple latch which holds load securely in position. Roura Iron Works, Detroit.

Unit Heater

"Trane Projection Heater" is a light-weight high-velocity unit of the propeller type, which conveys warm upper air in a building down to the floor, the occupied zone. Provides velocities equal to those obtainable with blower types but in a vertical air stream which carries a considerable distance and diffuses at the same time. Structurally, it consists of a two-row circular coil mounted between two circular plates. Upper plate is supporting backbone of the unit while the lower provides orifice through which the fan discharges. Warm upper air is drawn through the coils, then projected straight downward to the floor by the four-blade fan. Motor has three-point resilient construction. High ceiling mounting is intended. The Trane Co., La Crosse, Wis.



Flexible Coupling

"Rybeck" flexible coupling compensates for extreme conditions encountered in direct drives. It is of full-floating, semi-universal-joint design. Takes care of shaft misalignment, offset between shafts, end-play, and shock, without increasing bearing loads. Torsional load is transmitted through groups of laminated springs made of heat-treated Swedish spring steel. These springs are not subjected to any wear from endwise motion of the shafts, nor from angular or offset

Read how Shell kept this company's wheels turning... Averted large financial loss!

LOADS OF 25 TONS—temperatures as high as 300° F.—that means a tough lubricating job in any man's language! And that was the problem faced by Shell at the Technical Porcelain Company plant at El Cerito, Cal.

This company operates a kiln of the circular revolving type mounted on a track. Twenty-four plain-bearing wheels move the kiln at about 6 ft. per hour. The bearings must be lubricated once an hour by handgun as they pass a small opening.

Continual trouble was being experienced due to the bearings running dry and freezing at the high operating temperatures. With a large number of orders on hand, this company couldn't take a chance on further breakdowns! Shell was called in.

A thorough survey of all operating conditions was made. Then the Shell Bearing Lubricant perfected by Shell to meet tough operating conditions of just this kind was recommended and applied. The result of the application of that Shell Industrial Lubricant was *more* than just the elimination of frozen bearings! Today it is necessary to lubricate the bearings only twice a week—a real labor saving. Consumption of lubricants has been cut in half—another dollar-and-cents saving!

In every state in the Union—more and more industrialists are discovering that Shell has the "know how" to meet the tough problems of lubrication quickly, sensibly and economically.

We'd appreciate an opportunity to show you what modern lubricating methods can do for modern industry. Write or call your nearest Shell office.

SHELL'S "INVISIBLE ELEMENT" is a combination of Shell's unmatched world-wide resources; Shell's modern laboratories and refineries; years of cumulative experience in research by Shell's engineers and scientists. It is the determination to make lubrication more efficient, more economical for you.

SHELL

SHELL *INDUSTRIAL* LUBRICANTS

misalignment, since they are confined in a housing which eliminates any motion except deflection. Heat-treated alloy steel driving pins are pressed into steel hubs and fit into holes drilled into the torque sleeves. The sleeves are heat-treated to great hardness and are held in alignment by the housing which is securely bolted together. T. L. Smith Co., 2811 North 32d St., Milwaukee.

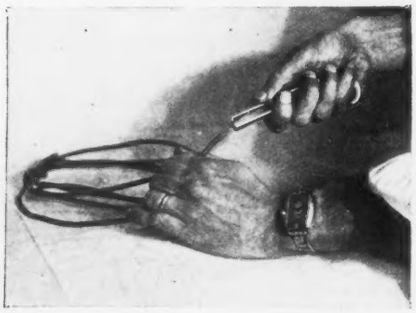
Reflector

Deep-bowl reflector for mercury vapor lamps is intended for general illumination in locations requiring high mountings. When combination of mercury vapor and

incandescent lighting is planned, this reflector may be used with 750-watt flood lamp. Quadrangle Mfg. Co., South Peoria St., Chicago.

Wire Skinner

This tool can be used to cut and strip insulation, scrape the wire and straighten kinks and sharp bends of electric wire. It is known as the "Handi-Grip." The hardened tool steel blades have the cut-



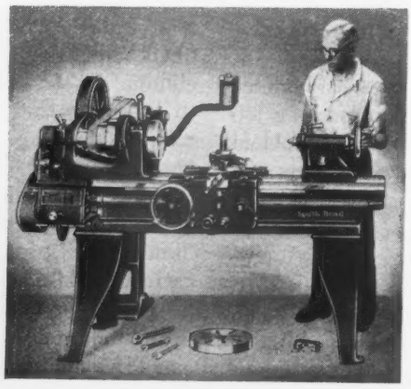
ting edges hollowed in the center to prevent the wire from slipping out of the tool. The blades are removable for resharpening. An aluminum handle hooks around the fingers to give pulling grip. The back of this handle is grooved to supply a means of straightening kinks and sharp bends in the wire. Pulling is done entirely with the handle, permitting sensitive pressure on the blades to give correct stripping. It is 5¼ in. long, has blade width of ½ in. Ideal Commutator Dresser Co., 1416 Park Ave., Sycamore, Ill.

Liquid Line Filter

Model CPHL Protectomotor is designed to filter lubricating oil to internal combustion engines. Radial fin construction permits a large area of filtering medium to occupy a relatively small space. Several sizes and models are available, most of them for horizontal lines. It is said to have high adaptability and to be easily cleaned. Staynew Filter Corp., Rochester, N. Y.

Lathes

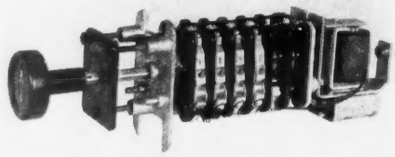
"Pedestal Adjustable Motor Drive Lathes" are back-geared, screw-cutting, precision lathes available in five sizes of 9, 11, 13, 15, and 16 in. swing, and in bed



lengths from 3 to 12 in. The motor-drive mechanism is a separate unit with the motor and countershaft mounted on a pedestal back of the lathe in a position horizontal with the headstock cone pulley. Power is transmitted from the motor to the countershaft by V belts, and from the countershaft to the lathe spindle by flat leather belt. Motor is entirely apart from lathe, eliminating vibration. Silent belt drive provides smooth, steady pull. Screw-type belt-tension adjustment for any desired pulling power. South Bend Lathe Works, South Bend, Ind.

Relay

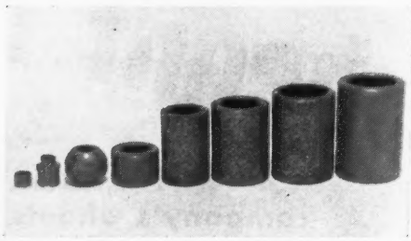
Type HEA high-speed, hand-reset, multi-contact auxiliary relay for switchboard mounting. Two models: HEA11A has 6-circuit contacts, HEA11B 10-circuit contacts. Particularly applicable where a number of operations are to be performed simultaneously. Principal parts are a



Type SB-1 switch equipped with three torsion springs which throw the contacts to the "operated position" when the trip coil is released. Small capacitor under the coil reduces arcing of the coil circuit contacts of 125- and 250-volt relays. Contacts are silver-to-silver and will carry 20 amp. continuously or 250 amp. for 3 sec. General Electric Co., Schenectady, N. Y.

Bearings

Self-lubricating bronze bearings are made of a porous metal impregnated with oil. Are said to be high in oil content, having an average porosity of 32 per cent which is fully impregnated with oil. Are said to be high in strength and able to stand rough



handling without distortion. Can be produced in any size, straight or flanged type, or in any shape which lends itself to molding. Keystone Carbon Co., St. Marys, Pa.

Lift Truck

Ladle-handling lift truck has vertical lifting arrangement, swinging arms, and a ladle-tilting mechanism to handle a ladle having a capacity of 2,000 lb. of molten iron. Height of hydraulic lift from floor to lip of ladle in pouring position can be adjusted from a few inches above the floor

● **Have you had a recent lubrication survey of your equipment? Are you sure that your machinery is being properly lubricated with the correct lubricant? Do you feel that you can afford to "let it go" for another year? Why not make sure and call a Pure Oil Industrial Engineer to make a survey of your plant and to suggest the type of lubricant best fitted for your special needs. Do it now!**

Comprising Pure Oil's Three Point Service is: 1. Selected Crude. 2. Skillful Refining and 3. Scientific Application.

THREE POINT SERVICE PURE THE PURE OIL COMPANY, U.S.A.

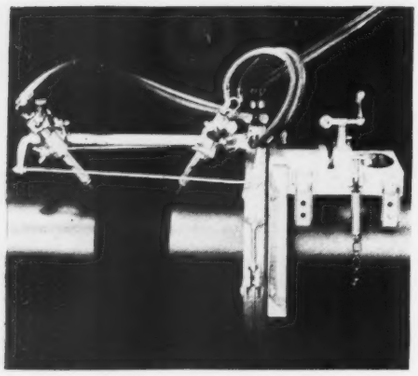
THE PURE OIL CO.

U. S. A.

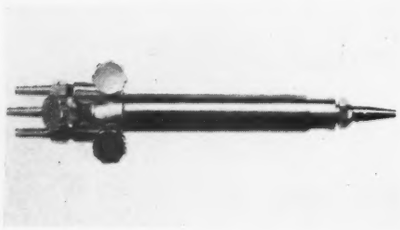
PRODUCERS, REFINERS, MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS

to any specified height. Ladle can be swung from one side to the other. Operator can control all movements from his position on the truck. Towmotor Co., 1233 East 152d St., Cleveland.

Pipe-Cutting Machine



Oxweld Type CM-13 pipe-cutting machine cuts and bevels pipe by the oxyacetylene process. Needs only one man to operate it, including setting up machine, performing cutting operation, and removing machine from pipe. Channel ring fits around the pipe and the ring and blowpipe can rotate around entire circumference of pipe in one cut. Additional blowpipe can be mounted on tube extension arm for double cutting or beveling. Comes in one size for cutting 8-, 10-, and 12-in. pipe.



Also available is a new blowpipe, Type C-35, designed particularly for use on the CM-13 machine. Has combination injector, making it possible to use it with either low-pressure or medium-pressure source of acetylene. Three hose inlets are provided so that three separate hoses for preheat and cutting oxygen can be used. It can also be operated using two hoses only. The Linde Air Products Co., 205 East 42d St., New York.

Welding Rod

Airco No. 1 high-ductility, alloy steel welding rod is claimed to have ultimate strength of 60,000 lb. per sq. in. Rockwell hardness of weld metal from B60 to B85, depending on carbon content of base metal and type of weld. Air Reduction Sales Co., 60 East 42d St., New York.

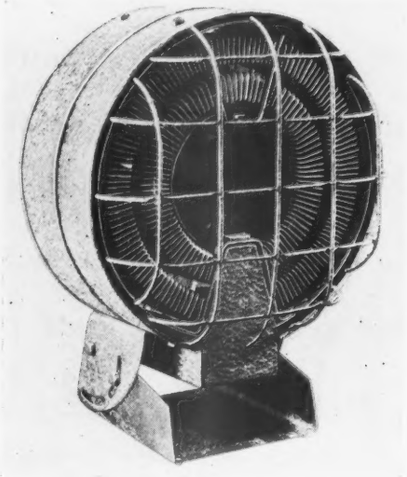
Steam Hose

Burst-proof steam hose will leak when it fails but will not burst unless an external blow cuts the wire reinforcement. It is designed for 200 lb. working pressure in all sizes. The tube and insulating layers are made of a special heat-resisting rubber compound. Two of the reinforcing layers are of high-tensile wire applied in braided form with openings large enough to permit the

rubber to rivet itself, thus preventing any possibility of tube collapse. Construction utilizes maximum strength of the wire so that no additional reinforcement is needed beyond a single ply of wire tape in small sizes and two plies in larger sizes. Outside of the wire braid and underneath the cover is embedded an additional braid of strong asbestos cord. This protects the cover from burning. Completing the construction is a heavy, black rubber cover. Hose is available in sizes ranging from ⅜ to 2½ in. The B. F. Goodrich Co., Akron, Ohio.

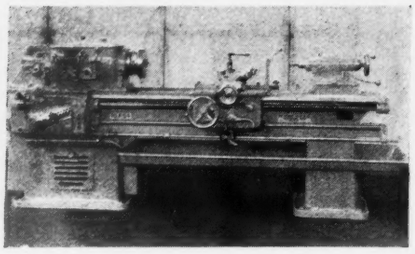
Unit Heater

Type UB electric unit heater consists of a Chromalox Koilfin heater mounted in a cylindrical housing. Motor is located in center of assembly and is cooled by the fan in addition to being protected from radiant heat by baffles. Available ratings from 2 to 20 kw. for operation on either 115 or 230 volts, single- or three-phase. Air velocity through heaters is 800-900 ft. per min. and temperature rise between 20 and 70 deg. F., depending on size of heater used. Base of heater adjustable for either wall mounting or portable use. Manually reset thermostatic cutout protects units from overheating. Edwin L. Wiegand Co., Thomas Blvd., Pittsburgh.



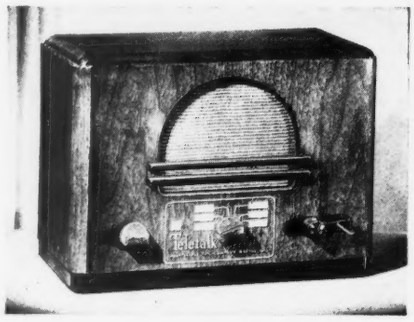
Lathe

Engine lathe has 18-speed geared head and is available in 12-, 14-, and 16-in. swing. The 18 speeds from the headstock to the spindle are obtained through a train of 13 gears. All sliding gears are hardened and tempered. Headstock is adaptable so that low and high spindle speed ranges are available to suit customers' needs. Spindle may be furnished with either long-taper key drive nose or D cam lock flange-type nose. Rear end of spindle is graduated for multiple thread cutting. Gear box has built-in pushbutton control for motor with current signal light. Apron has quick-action feeds, lever-controlled. Crossfeed is developed for cutting service. Tool slide has quick withdrawing attachment for thread cutting. Feed dials are large for easy, accurate reading. The Hendey Machine Co., Torrington, Conn.



Communicating System

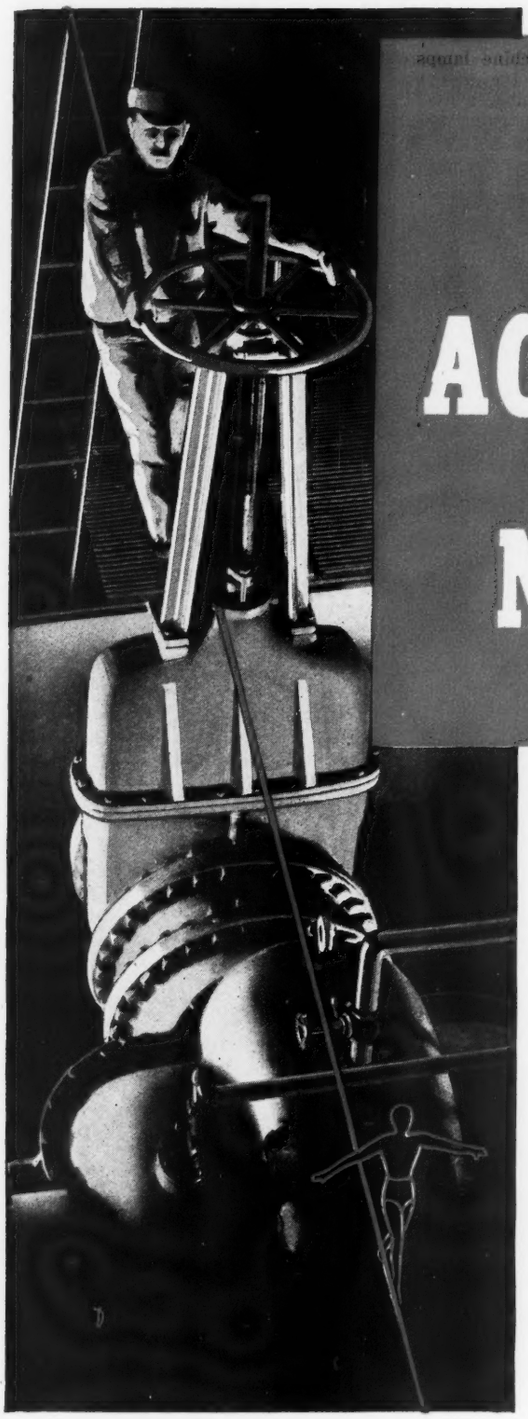
Model 105 "Teletalk" is a loud speaker system where inter-communication between one point and one to five remote points is desired either as a group or selectively. Consists of one master station which is selective and which controls direction of conversation and originates call to remote



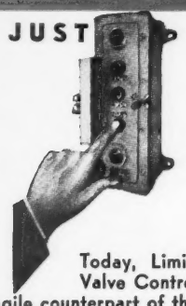
speaker stations. These stations can answer the master station only when called. Communication with 14-gage wire can be carried on over a distance of 3,000 ft. Cabinets are of walnut. Webster Electric Co., Racine, Wis.

Vise Stand

"Vulcan" Vise Stand No. V-1 is a portable unit combining stand, chain pipe vise and pipe bender. Base is made of malleable iron, legs are 1-in. pipe with upset



NO ACROBATS NEEDED

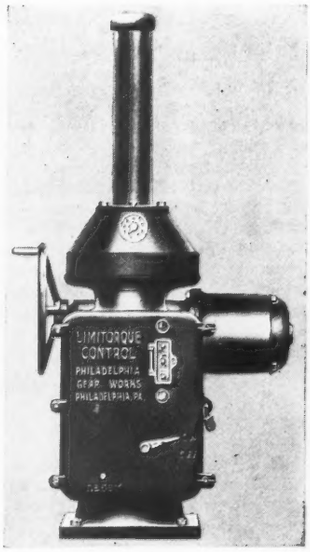


JUST A TOUCH ON THE BUTTON OPENS OR CLOSES THE VALVE--- HOLDING TORQUE TO A PREDETERMINED LIMIT

Today, Limitorque Automatic Valve Control makes Industry's agile counterpart of the tightrope walker unnecessary. Just the push of a button opens or closes these valves, regardless of their out-of-the-way location.

Furthermore, as the name implies, Limitorque automatically limits the torque applied to the valve stem and thus offers positive protection against breakage or damage to valve stem or gate. The torque may be changed, whenever desired, by a simple adjustment.

Engineers with more than 20 years' experience in valve controls and similar devices, have designed and perfected Limitorque. Get our new catalog.



Philadelphia Limitorque Floor Stand Controls are designed for operating large valves and sluice gates where it is impracticable to attach the control unit directly to the valve yoke. These Floor Stand Controls are usually mounted directly over the gate stem but can be located at any angle by means of auxiliary gearing and necessary supports.

PHILADELPHIA *Limitorque*

PHILADELPHIA GEAR WORKS

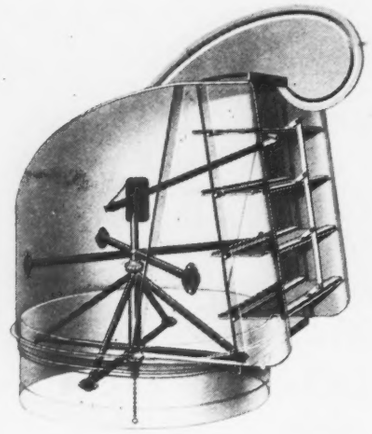
Industrial Gears and Speed Reducers

ERIE AVENUE & "G" STREET, PHILADELPHIA, PA.

feet punched for fastening to the floor. Legs fold for carrying and are held together by simple tie chain. Vise jaw is of hardened and tempered tool steel. Finished in orange enamel with black legs, weighs 35 lb., takes pipe ⅛ to 2 in. Pipe bender handles pipe up to ¾ in. J. H. Williams & Co., 75 Spring St., New York.

Roof Ventilator

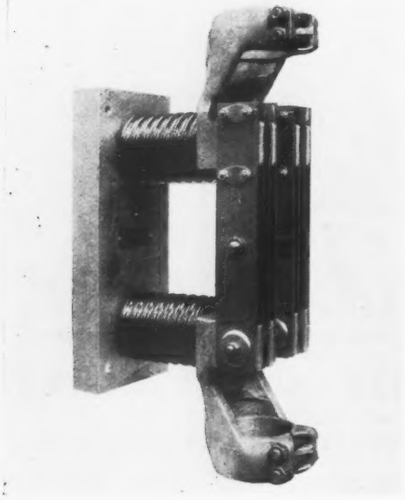
Rotary roof ventilator has stainless steel, fully inclosed, dust-tight oilless ball bearings on which the head turns with the wind. Interior construction is of streamlined steel tubing welded into a one-piece head frame. Body is designed along modern lines resulting in a low, pleasing appearance with a



slightly increased area in the discharge opening. Made in sizes from 12 to 72 in. throat diameter. The Swartwout Co., 18625 Euclid Ave., Cleveland.

Disconnecting Switch

Single-pole unit of a three-pole switch has tongue-type silvered contacts engaged by double full-floating blades. Terminals integral with the switch contacts are of the clamp type for connecting 4-in. copper tubing. Wet process porcelain insulators have metal inserts to which the switch parts are bolted. All bolts, nuts, and washers on the live parts are non-ferrous. Rated 4,000 amp., 23 kv. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.



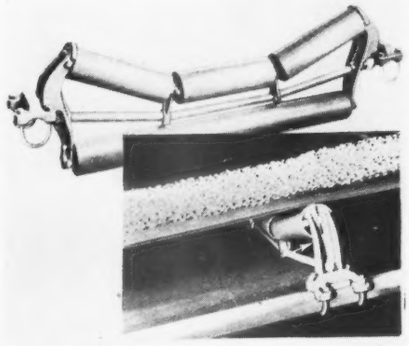
Lamps

Nos. 71 and 72 sewing machine lamps. No. 71 is equipped with a stud for direct attachment to the sewing machine, while No. 72 has a cast base for fastening to

table or bench. Operate on either 110-115-120 volts or 6-8 volts. Both use double-contact candelabra lamp with bayonet base, accommodating lamps up to 2¾ in. in overall length. On 110-115-120-volt circuits a 25-watt lamp is used, on 6-8-volt type a 15-candlepower lamp. Finish is machine gray with black or green optional. The Fostoria Pressed Steel Corp., Fostoria, Ohio.

Conveyor Carrier

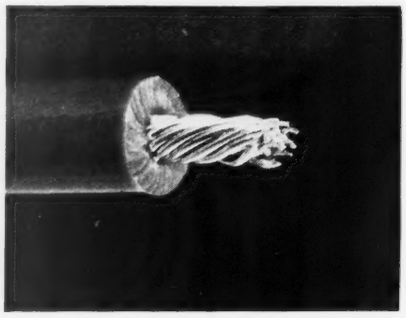
Light-weight, ball bearing conveyor carrier is supported on a frame of two parallel 2-in. pipes. Carrier brackets are clamped to the pipes without boring holes, and carriers can be shifted when neces-



sary. Rocker-type mounting permits carrier to tilt in either direction with the travel of the belt. Has three-roll design in which outer rolls are inclined to trough belt at 20 deg. Rollers turn on cartridge-type ball bearings, lubricated and sealed at the factory. Two styles: one consists of carrier only, second includes carrier and return roller. Stephen-Adamson Mfg. Co., Aurora, Ill.

Cable

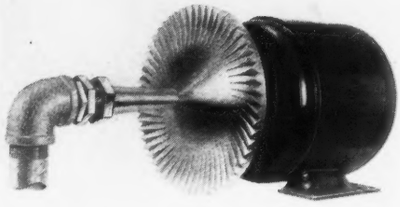
"Flamenol" is the name of a new synthetic insulating compound similar to rubber in its characteristics, which contains no rubber and will not support combustion. It is being used on cable that is recommended for power and control circuits at 600 volts and less, and for operation at a maximum copper temperature of 60 deg. C. "Flamenol" has a smooth finish and foreign



materials do not readily adhere to its surface. It is highly resistant to moisture, acids, alkalies, and oils, and is strong mechanically. Available in a variety of colors for circuit tracing. Is used without any protective finish, such as braid, lead, or armor. General Electric Co., Schenectady, N. Y.

Spray Wheel

"Murray-Preston" spray wheel is adaptable to air washers or other equipment having banks of spray nozzles. It is suitable for high-temperature cleaning or recovery because it is made of metals or alloys to meet specific chemical or corro-



sion conditions. Spray medium is integral part of entire unit. Delivery is through the nozzle and the spray wheel cannot become clogged. It is self-cleaning, and furnishes a steady, uniform spray. Direct-connected motor is splashproof, totally inclosed type. D. J. Murray Mfg. Co., Wausau, Wis.

Cleaning Material

"Solvenite" is a granulated material which removes hardened grease, oils, and wax from steel, iron, and machinery parts. It penetrates the dirt binder and breaks it into tiny particles easily rinsed away. If allowed to dry on the metal surface, the solution forms a protective film. Leedan Products Co., 120 Liberty St., New York.

Lubrication Line Connection

The "Bijur Drive Bushing Connection" is a tubing unit for connecting lubrication feed lines in tight places. Small tapered brass bushing has a center hole to slide readily over the particular size of tubing used. This bushing is mounted into a shallow hole which is taper reamed. The drive bushing is placed into the mounting hole and the tube inserted as far as possible. Then by means of a simple drive tool, one or two blows with a hammer will drive the bushing home. The taper fit causes the bushing to grip the tubing tightly and make an oil-tight and dirt-proof joint.

CONDOR WHIPCORD V-BELTS

Industry's Turning Power is its Earning Power . . .

Condor Whipcord V-Belts on large electric driven slush pump in Oklahoma Oil Field

WITH the starting hum of the motor, Condor Whipcord V-Belts seat themselves firmly in the sheaves . . . pick up power smoothly . . . transmit it steadily, constantly to the driven unit.

Day in, day out the performance of Condor Whipcord V-Belts remains the same . . . slip, stretch, internal breakdown have been minimized by placing the endless whipcord strength member in the neutral axis area with an extensible section above, a compression section below.

This original Manhattan construction results in 9-Points of Balance that keep power, production and maintenance costs consistently lower . . . industry's profits consistently higher.

For more turning power . . . and greater earning power . . . put Condor Whipcord V-Belts on your drives. You will find their uniformity, balance and longevity, even in the most difficult service, will result in lower cost sheets.

Condor PRODUCTS

Transmission Belt
V-Belt
Conveyor Belt
Air Hose
Contractors Hose
Sand Blast Hose
Suction Hose
Fire Hose
Hydraulic Hose
Steam Hose
Water Hose
Chute Lining
Launder Lining
Industrial Brake Blocks and Lining
Molded Rubber Goods
Rubber Lined Tanks
Rubber Covered Rolls

Abrasive Wheels—Rubber Bonded

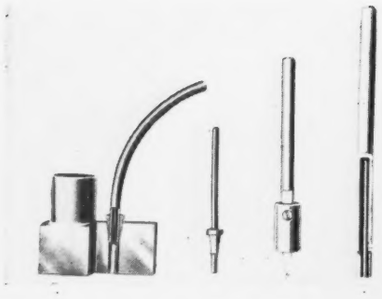
9-POINT BALANCED CONSTRUCTION

1. Minimum Inelastic Stretch.
2. Wide Margin of Strength.
3. Uniform Flexibility.
4. Maximum Resistance to Structural Breakdown.
5. Smooth Running.
6. Maximum Traction.
7. High Resistance to Side Wear.
8. Correct Lateral Reenforcement.
9. Matched Length.

SOLD BY LEADING JOBBERS

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.

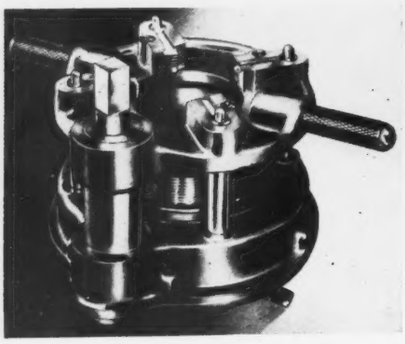
EXECUTIVE OFFICES AND FACTORIES, 46 TOWNSEND ST., PASSAIC, N. J.



Tubing as small as 3/32 in. outside diameter can be connected. Bijur Lubricating Corp., 43-01 22d St., Long Island City, N. Y.

Pipe Threader

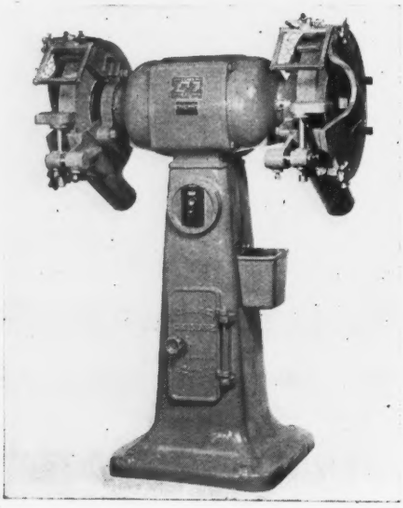
No. 48-R semi-adjustable taper-post-type pipe threader for threading 2½-, 3-, 3½-, and 4-in. pipe. Has four sets of dies, one for each size. Features extra wide die, with throat to center and hold tool on



the pipe, fully inclosed gears, "straddle-mounted" driving pinion, spring-backed ball to hold dies in position, proper position for setting dies marked in taper post. Is semi-adjustable for cutting oversize or undersize. Beaver Pipe Tools, Inc., Warren, Ohio.

Grinder

This 3-hp. floor grinder can be used for toolroom work or production grinding. Safety features include hood adjustable for wheel wear, shatter-proof glass eye protection. Rotor shaft is mounted in heavy-duty, precision-type ball bearings, grease-lubricated. Motor is totally inclosed, rated at 3 hp. for constant duty at 1,750 r.p.m. Motor is wound for 220/440 volts, 50-60 cycles, 3-phase, a.c. Can also be wound for 550 volts, 3-phase, a.c., odd cycles, and d.c. James Clark Jr. Electric Co., Louisville, Ky.



pH Papers

"pH Indicator Papers" offer a method of determining pH of plating solutions in a few seconds time. They consist of strips of special paper impregnated with a highly sensitized indicator and a scale of color bars, each bar being of a different color and having a definite pH value. When the strip is dipped into the solution the indicator will change color. By comparing the indicator color with colors of the color bars, the pH value of the solution can be easily determined. Available in seven pH ranges, from 0.9 to 13.5. The Udylite Co., 1651 East Grand Blvd., Detroit.

V-Belt

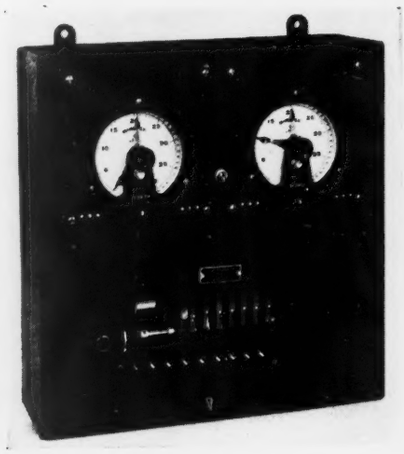
"E-C Cord Multi V-Belt" is precision built, featuring close matching of V-belts used in multiple. Load is carried by layer of heavy, low-stretch, high-tensile cord, placed in a neutral section between rubber high-tension and high-compression sections. Surface wear is taken by an elastic fabric envelope with the weave on the bias. Goodyear Tire & Rubber Co., Akron, Ohio.

Spanner Wrench

No. 865 heavy-duty spanner wrench has self-adjusting jaw, is drop forged from chrome-vanadium steel and heat treated. Has capacity of 1½ to 4½ in., overall length of 21 in. The Herbrand Corp., Fremont, Ohio.

Furnace Timer

Type 2700 Timer, controls reversal of firing in soaking pits, open hearths, glass melting furnaces, and other heating operations. Time of firing at each end is regulated automatically according to a preset cycle. Operator has at all times direct reading of the progress of the firing cycle. Firing cycle of the furnace is the sum of the index settings of the two dials. Firing



time for either end can be changed during operation, and to prevent unauthorized change in settings; locked covers for the adjusting knobs are provided. Automatic Temperature Control Co., 34 East Logan St., Philadelphia.

Control Valves

Style J is a control valve in 3- and 4-way types for operating single- and double-acting cylinders utilizing air or oil on pressures up to 125 lb. Made in ¼-, ⅜-, ½-, and ¾-in. sizes, of flat-disk, protected-seat design, with bodies and seats of semi-steel, disks of bronze. Port areas are equivalent to full area of pipe sizes they accommodate, and port design permits throttling or full opening. Operating levers require 90 deg. travel for complete cycle. W. H. Nicholson & Co., 228 Oregon St., Wilkes-Barre, Pa.

Saw

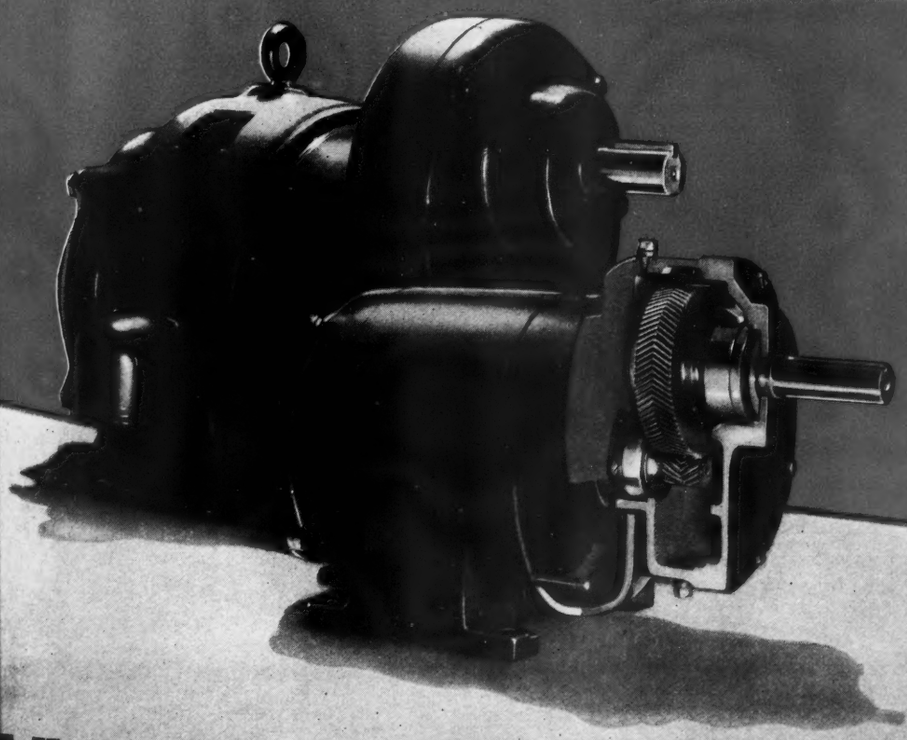
W9 safety saw is motor driven, with cutting capacity of 3¼ in. Has tilting base for making bevel cuts up to 45 deg. in 2¼-in. material. Stationary and swinging guards keep cutting edge of blade covered at all times. Aluminum alloy housing. Heavy-duty alloy steel worm gears and bronze worm wheel which run in large grease chamber. Double-pole switch. Stanley Electric Tool Division, The Stanley Works, New Britain, Conn.

Paging System

Automatic paging system consists of transmitter that is placed on a telephone desk and signal stations (chimes, gongs, or horns) located where necessary and interconnected by means of ordinary low-voltage wire to the transmitter. Trans-

Only MASTER Geared Motors have all these features

- COMPACTNESS—High ratios of reduction are secured in small space through use of alloy steels, splined shafts and heat treated gears.
- HERRINGBONE GEARS greatly increase the strength and efficiency.
- RESPONSIBILITY—Both the motor and the gear unit are products of one organization.
- ANTI-FRICTION BEARINGS throughout.
- EFFECTIVE LUBRICANT SEALS.
- SIMPLIFIED DESIGN—fewer wearing parts.
- A COMPLETE LINE—1/10 to 100 HP.

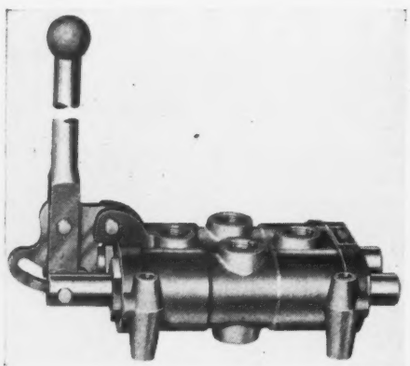


THE MASTER ELECTRIC COMPANY
DAYTON, OHIO

mitter operates from any 110-volt a.c. outlet; signals on 24-volt a.c. which is supplied by the transmitter without necessity of accessory equipment. Coded calls may be made to repeat continuously or sound once. Codes are initiated by turning knob on dial to name of individual wanted, and then pulling it out. There is an additional button to be pressed to sound emergency or time signal. The Babaco Co., 447 West 19th St., New York.

Hydraulic Valve

Hand-lever-operated, bronze, forged housing valve comes for two, three or four-way operation. It is made in ½-, ¾-, and 1-in. sizes; in two styles, for 1,000 lb. working



pressure and for 2,000 lb. Plungers are made of stainless steel and are free floating in special packings, avoiding metal-to-metal contact. Inspection and replacement of parts can be made easily and quickly. Connections are provided so that the piping can be connected above or below the housing. C. B. Hunt & Son, Salem, Ohio.

Socket Set

No. HA-82½ heavy-duty socket set can be used on openings from ⅞ to 2 in. Sockets have straight walls, have lock-on feature that holds them securely to the handles. Forged from chrome-molybdenum steel and heat treated. Set consists of 6 handles and 16 sockets with 12-point openings. The Herbrand Corp., Fremont, Ohio.

Sheave

"End-Wood" sheave is to be used for fastening to shafts or fitted with oilless "End-Wood," ball, or roller bearings. It is made to specifications in all sizes. Made of hard maple, it is chemically treated, of all-wedge construction, and with "End-Wood" groove that is said to be easy on belts, ropes or cables. Is said to be silent in operation. Metzgar Co., Grand Rapids, Mich.

Flexible Coupling

L-R Type WQ flexible coupling carries load on free-floating load cushions between metal jaws, and has one set of jaws made in the form of a removable ring. This ring is held in place and driven by 3, 5, 7, or 9 hexagon-head, alloy steel capscrews which operate from the jaw body. Jaw ring can be pulled to one side leaving clearance ample for rotating either half of coupling, a valuable feature on engines which must be set or timed. Three types of load cushions are available for different load conditions. Made in standard sizes with bore from 1½ to 14 in. (2 to 2,000 hp. at 100 r.p.m.). Lovejoy Flexible Coupling Co., 4963 West Lake St., Chicago.

Valves

Type H solenoid valve is intended for control of water supply to air conditioners and humidifiers. It can also be used to control gas, oil, and other liquids. By use

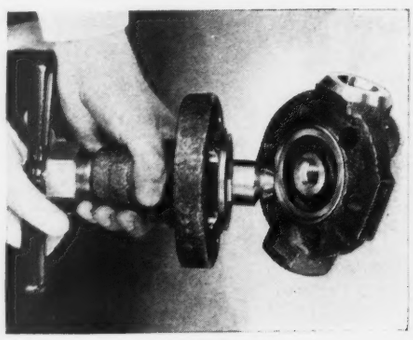
of a rubber pad the upper end of the plunger travel is silenced to give very quiet operation. Valve seat and plunger are removable for easy cleaning. Connections may be for ⅛, ¼, or ⅜ in. pipe, with orifice 1/16 or ⅛ in. in diameter. Supreme Electric Products Corp., Rochester, N. Y.

Lubricating System

"Flex-O-Matic" injector system is a lubricating system applying an accurately measured amount of lubricant to a bearing. Full pressure of the lubricant in the supply line is available to discharge the measured shot from the injector. Consists of lubricant compressor, manually or power-operated, a supply line leading from compressor to the vicinity of bearings to be lubricated, and injectors mounted either on the bearings or in proximity of the bearings and connected to them by means of tubes, hoses, or pipes. Automatic vent valve relieves pressure in supply line at predetermined point and returns excess lubricant to the compressor. In the automatic system, the valve also stops the compressor. Four capacities: 0.14, 0.10, 0.07, and 0.04 oz. Lincoln Engineering Co., 5701 Natural Bridge Ave., St. Louis, Mo.

Valve

"Duravalve" is designed for high-pressure and high-temperature service (1,500 lb. at 950 deg. F.). Internal Stellite seats are claimed to prevent steam leaking between valve seat ring and valve body. Seat facing can be easily welded in and serviced. Made in one basic size and then tapped, or bored for welding, for ½-, ¾-, or 1-in. pipe. Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.



Galvanized Sheet

Galvanized iron or steel sheets and strips, known as "Zincgrip," have a heavy coating of commercially pure zinc that is said not to crack or peel when subjected to relatively severe drawing or forming operations. Available in thicknesses from 16 to 28 gage. The American Rolling Mill Co., Middletown, Ohio.

•

TRADE LITERATURE

Batteries—Booklet, title "Electric Starting of Diesels."—The Electric Storage Battery Co., Allegheny Ave., and 19th St., Philadelphia.

Brakes—Bulletin GEA-1518, on CR9516 shoe-type Thrustor brakes for a. c. motors.—General Electric Co., Schenectady, N. Y.

Bronze Bar Stock—Folder, on semi-finished bronze bar stock.—Magnolia Metal Co., 120 Bayway, Elizabeth, N. J.

Cans—Catalog, covering line of corrugated cans.—The Witt Cornice Co., Winchell, Koebel, and Patterson Sts., Cincinnati.

Capacitors—Catalog No. 143, on line of capacitors for power factor correction.—Cornell-Dubilier Electric Corp., South Plainfield, N. J.

Chemical Equipment—Bulletin No. 37,300, covering line of chemical and industrial equipment.—Read Machinery Co., Inc., York, Pa.

Combustion Regulators—Bulletin D-R 34, on oil-operated regulators for combustion control.—Hagan Corp., Pittsburgh.

Compressors—Bulletin 762, on diesel engine-driven compressors, one a portable type, the other stationary.—Chicago Pneumatic Tool Co., 6 East 44th St., New York.

Contactor—Bulletin GEA-2577, on Size 00 a. c. contactor, CR2810—General Electric Co., Schenectady, N. Y.

Control Equipment—Catalog, covering air control line and new line of hydraulic valves.—C. B. Hunt and Son, Salem, Ohio.

(Continued on page 160)

SHAFER

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For Heavy Duty Service

is the result of the exclusive Shafer CONCAVE roller design. In average installations there is an ample reserve capacity. Only Shafer combines 1. Integral self-alignment, 2. Capacity for radial, thrust, or combined radial-thrust loads, 3. Simple adjustability.

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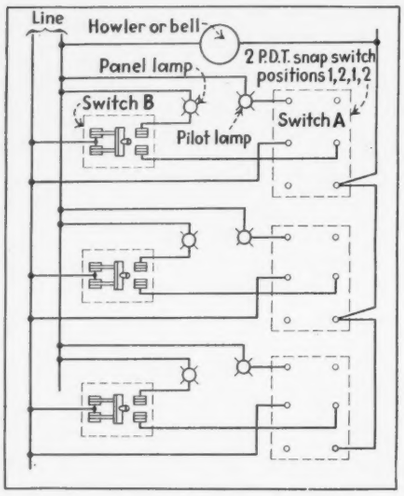
Operating Shorts

Signal System Gives Audible and Visible Alarms

L. E. STEINER, *Electrical Engineer Premier-Pabst Corporation, Milwaukee*

A large number of different signals were formerly used to indicate trouble on various pieces of machinery. To simplify matters a system was devised which gives an audible signal and at the same time lights a lamp indicating the location of the trouble, in a cabinet that has a separate panel with a glass front for each important position. The connection diagram is shown in the sketch.

When the signal sounds the operator manipulates switch *A*. This cuts off the audible signal but leaves the panel lamp burning and turns on a pilot lamp opposite the lighted panel. The operator then goes to the location of the trouble, which



may be in another part of the plant. Anyone looking at the annunciator can tell where to find him.

When the trouble has been remedied contact or switch *B* returns, or is returned, to its normal position, turning out the panel light but leaving the pilot lamp burning. To clear the board and restore the audible signal to that circuit, switch *A* is turned to the next position. This turns out the pilot lamp.

Cutting the audible signal off one panel by manipulating switch *A* leaves the signal on all of the other circuits. If trouble develops at some other place the signal will sound and the proper panel will light up. Another switch *A* opposite the lighted panel will cut off the signal and turn on the pilot lamp for that panel, and so on.

With this arrangement the operator always has an indication of whether the signal is connected to all circuits. If the panel is in the normal position, awaiting an alarm, it will be entirely dark. If a signal has been given and the horn cut off that circuit, the pilot light will still be on, even though operation of switch or contact *B* has turned out the panel lamp.

It will be seen that switch *B* is located at or near the machine to be protected, and may take the form of a knife or snap switch, a mercury switch, or a relay. A knife or snap switch will, of course, be operated manually by the foreman or operator. A mercury switch or relay will be operated by a thermostat, pressure switch, or other device. For example, a relay could be connected across the terminals of any electrical device to give a warning in the event of voltage failure, or excessive current.

Mr. Steiner's contribution has been awarded the $15 payment offered by the editors for the best Operating Short submitted during the past month.

•

Filing Cabinet for Graphic Instrument Charts

WALTER J. HOLMES, *New York*

The problem of how to file charts from graphic instruments so that they will be properly protected and at the same time readily available for reference frequently comes up. It has been worked out in one large establishment in the manner shown in the illustration.

The charts are placed over wooden pegs fastened to shelves in a large cabinet. These shelves can be pulled forward, or removed and placed on a table, if desired.

This cabinet will accommodate all

charts taken during the preceding twelve months. Older charts are kept in a dead file.

Difficulty in packing an ointment—solid at ordinary temperatures—in tins was overcome by building electric heating units into the packaging machine. Now the ointment is heated to the point where it flows and neatly fills the tins.

Ingenuity Simplifies Punchpress Repair

CHAS. H. WILLEY, *Penacook, N. H.*

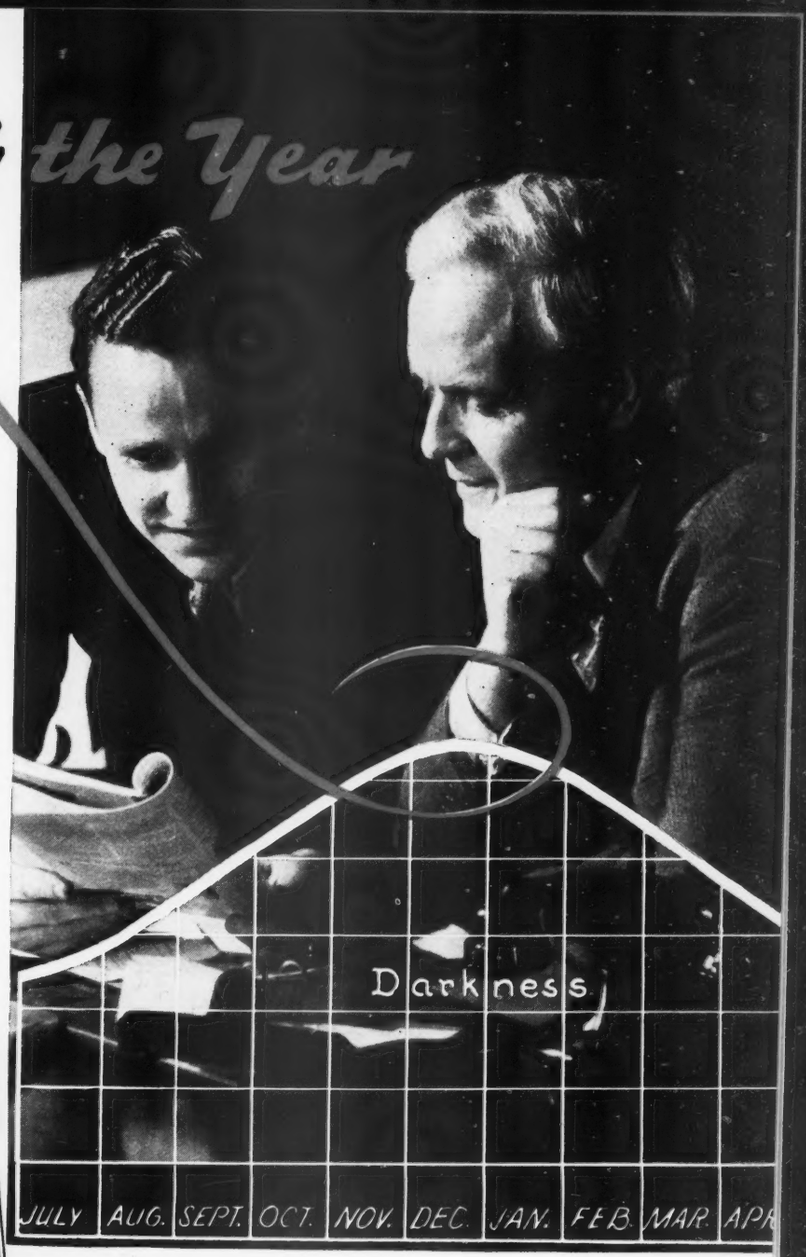
A heavy die is used for blanking and piercing a 2½-in. diameter magnet blank out of steel 0.075 in. thick. The stripper was actuated by pressure pins from a rubber buffer suspended from the die by a piece of pipe screwed into the bottom of the cast-iron die shoe.

During a very busy period recently the threads in the die shoe stripped and the pipe and buffer dropped to the floor. To put things back as they were would have involved removing the die, enlarging and rethreading the hole in the shoe, and cutting and threading another, larger, piece of pipe. Therefore, the scheme shown in the sketch was worked out.

As will be seen, it was necessary to use only a long piece of pipe, and make two adjusting rings. Two pieces of 3x10-in. plank were nailed together, placed on the floor under the die, and a hole cut for the slugs. The heavy rubber buffer was then placed on the planks. On top of it were laid the bottom pressure plate, with the new pipe, the adjusting rings, and the top pressure plate all assembled together. After this had been done it was merely necessary to screw up the adjusting rings. The time required to get the press

The Best Time of the Year

to Checkup on your LIGHTING is NOW

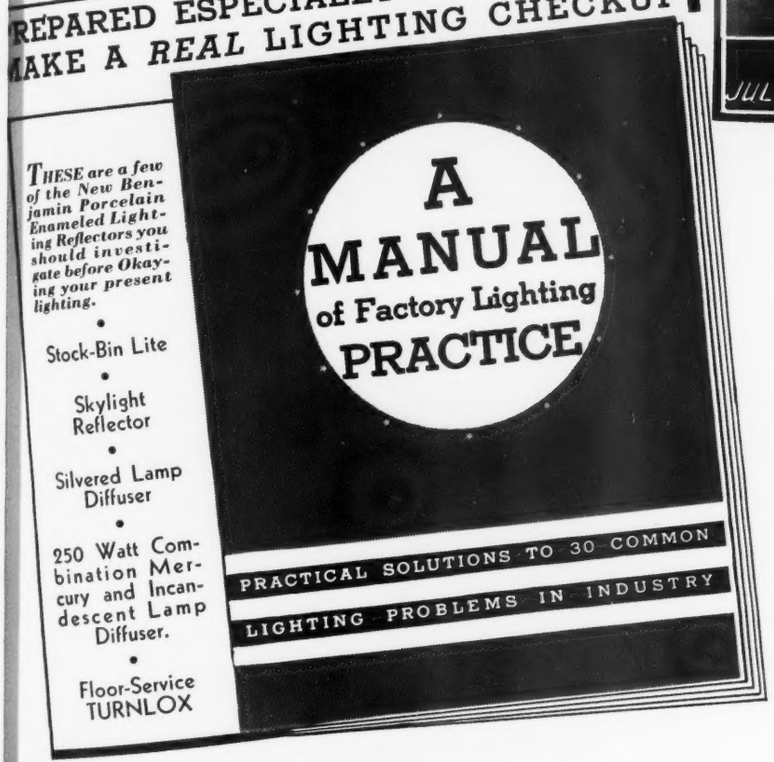


TAKE a walk through your plant during a dark November day when glare and lighting deficiences are most evident. But don't be content if, even then, your lighting appears satisfactory.

Lighting deficiences, with their consequent effect on quality standards and production costs, are rarely apparent to the layman unless he has some standard with which to compare his lighting . . . some guide to point out what to look for . . . some solution that illustrates the answers to the problems of proper lighting for the various locations in his plant.

Such a book has been prepared by Benjamin. To management, "A MANUAL OF FACTORY LIGHTING PRACTICE" gives a new insight into the breadth and scope of modern industrial lighting. To the operating executive it is a guide with specific working data for the betterment of plant lighting. Send for this Manual and check your lighting with the lighting standards outlined in it before you are satisfied that your present lighting is as good as it ought to be. Mail the coupon today.

PREPARED ESPECIALLY TO HELP YOU MAKE A *REAL* LIGHTING CHECKUP



THESE are a few of the New Benjamin Porcelain Enameled Lighting Reflectors you should investigate before Okaying your present lighting.

- Stock-Bin Lite
- Skylight Reflector
- Silvered Lamp Diffuser
- 250 Watt Combination Mercury and Incandescent Lamp Diffuser.
- Floor-Service TURNLOX

WORTH knowing about are the many new and improved types of lighting reflectors introduced by Benjamin during the past year. These latest developments solve many special lighting problems. For example, the *Skylight Reflector* for inspection operations; the *Stock-Bin Lite* for stock room aisles; the *Floor-Service Turnlox* for safer, lower cost maintenance. Of further interest is the improved efficiency of Benjamin RLM *Dome Reflectors* and their porcelain enameled reflecting surfaces so necessary to uniform and diffused lighting. See how these developments can be applied to improve your lighting by sending for a free copy of "A Manual of Factory Lighting Practice."

BENJAMIN LIGHTING EQUIPMENT

Distributed Exclusively through Electrical Wholesalers

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Please Send Me a Complimentary Copy of Your New Factory Manual

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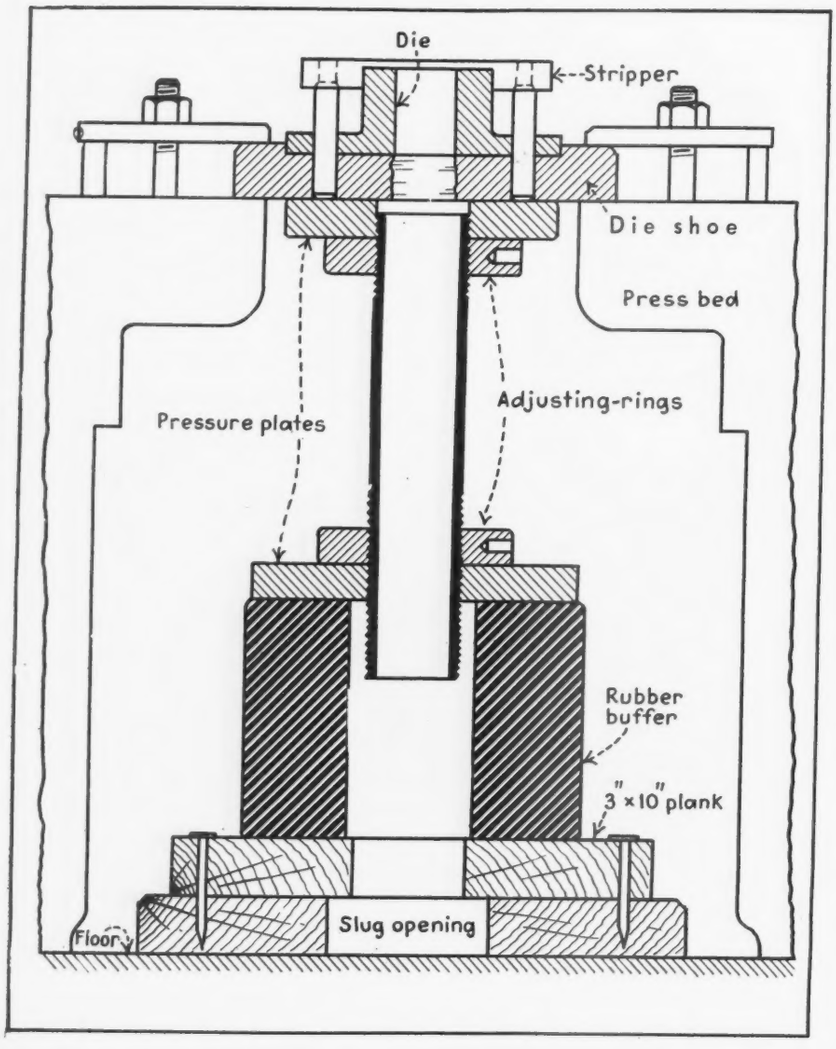


in service again was about three-quarters of an hour.

This emergency expedient worked so well that the die setter now uses it whenever he can. It is much easier than trying to attach a heavy buffer and pressure plates to the bottom of the die. Everything is supported from the floor and is easy to handle.

When welding, be watchful of where pieces of molten metal fall. They are a fire hazard.

Solder Pots on Casters

SOURCE, *General Motors Truck & Coach Pontiac, Mich.*

A great deal of time is saved in soldering operations at General Motors Truck & Coach by mounting the solder pots on casters. Workmen in the wiring harness department have long sets to wire up and solder at the joints. These harnesses are assembled on benches. Each workman would either require several solder pots to be kept heated for his use, or else he would be forever walking back and forth. As it is, with his solder pot hooked in on an overhead plug, he moves it back and forth with him.

If You Need a Paint That Resists Acid Fumes

C. C. HERMANN, *Philadelphia*

Paint applied in chemical laboratories and other places where conditions are severe often suffers decided depreciation in color within a short time. This is due, of course, to attack by acid fumes. The fumes then attack the underlying metal surface, which the paint is supposed to protect.

I tried various kinds of paint for this service in an attempt to find one that would protect the metal surfaces, present a pleasing appearance, and have high light-reflecting quality. Aluminum paint has good light-reflecting qualities and serves well under some conditions. Certain acids, however, attack it readily. After about six months I noticed that it began to flake off, and the under side of the flakes were coated with iron oxide. This indicated that the acid fumes were penetrating the coating and attacking the metal surface.

Eventually I hit upon the idea of protecting the paint film by a coat of clear Bakelite varnish. This material, although very smooth and glossy after application, darkens after a few weeks to an amber shade which is permanent. Altogether it seemed to be very satisfactory and was adopted.

In preparing the surfaces for painting, they were thoroughly cleaned and all rust spots sandpapered. All of the old paint which had been affected by the acid fumes was removed. Pipes were given particular attention. The surface was then given a coat of aluminum mixed in a Bakelite vehicle, followed by a coat of clear Bakelite varnish. This treatment was applied to all metal and wood surfaces.

Cement and brick were given a coat of white enamel, followed by a coat of the Bakelite varnish.

In four years there has been no apparent deterioration.

The initial cost is somewhat higher than for ordinary paints, but when the long life is taken into consideration the cost of application is preponderantly in favor of the higher-priced aluminum paint.

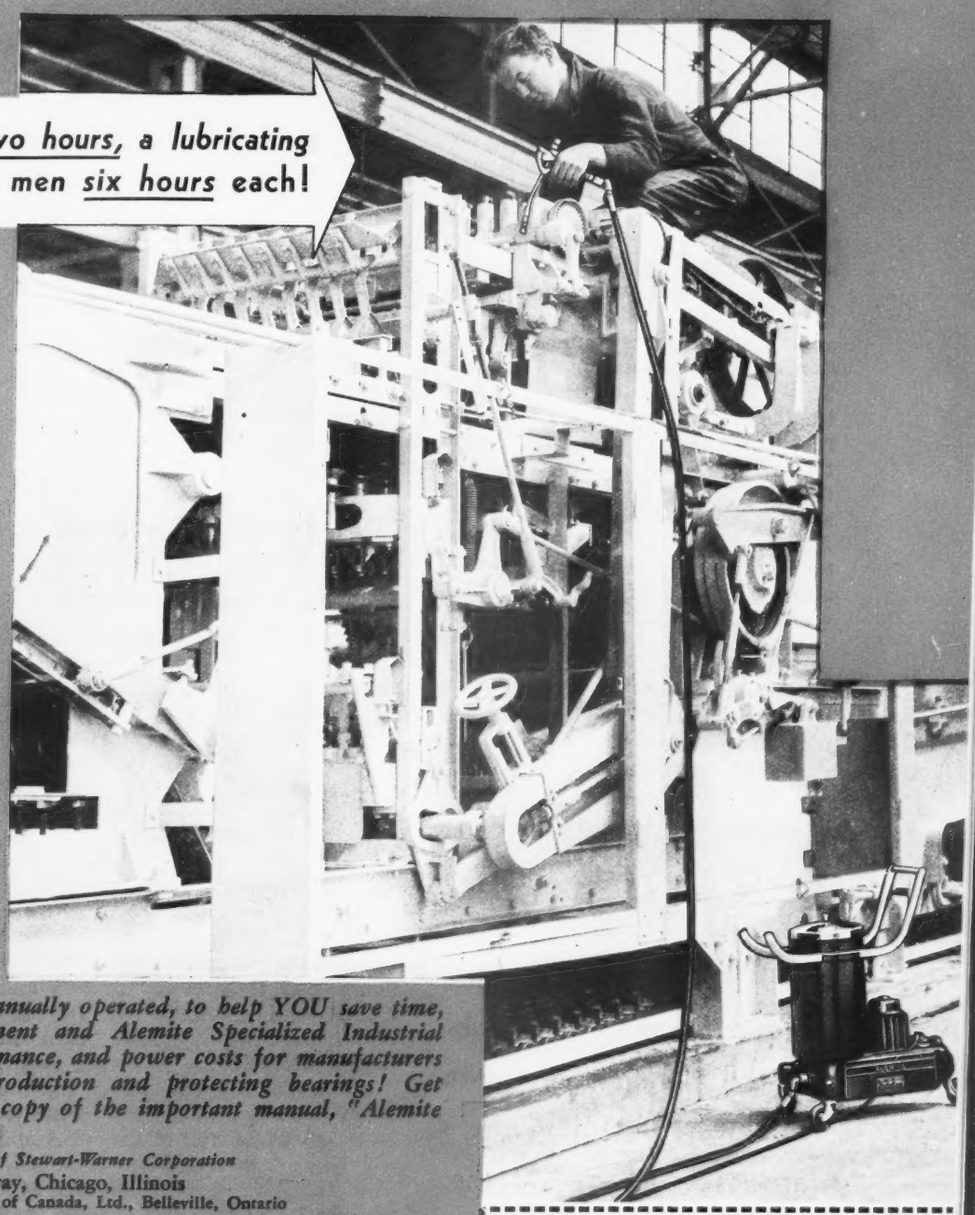
Covering capacity of the aluminum paint is 800 to 1,000

MACHINES NOW LUBRICATED

6 Times as Fast

Since Adopting Alemite Power Guns

This man is doing alone, in two hours, a lubricating job which formerly took two men six hours each!



That's the kind of savings the Liquid-Carbonic Company of Chicago introduced when they put a Model 6190 Alemite Electric Power Gun on the job of lubricating this eight-wide Super-Kleen Washer.

Similar savings are being made in lubricating their 16-wide Super-Kleen Washer. Alemite No. 33 Solidified Oil, which is highly water-repellent, is the lubricant used on both machines. It has proved its ability to protect highly polished bearing surfaces not only during the vital "breaking-in" period, but also under sustained severe operating conditions.

Liquid Carbonic, the country's largest manufacturers of bottle-washing machinery, uses Alemite 33 Lubricant for the initial lubrication of all these machines.

There is an Alemite System, power or manually operated, to help YOU save time, money, and machines! Alemite Equipment and Alemite Specialized Industrial Lubricants are cutting lubrication, maintenance, and power costs for manufacturers in every line of industry—speeding production and protecting bearings! Get all the facts now! Send for your FREE copy of the important manual, "Alemite Controlled Lubrication."

ALEMITE—*A Division of Stewart-Warner Corporation*
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Please send my FREE copy of your new manual, "Alemite Controlled Lubrication."

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sq. ft. per gallon, as compared to 300 to 500 sq. ft. per gallon for ordinary paints.

Make it a strict rule that broken bottles, or any other broken glass, are never placed in waste paper cans.

Making Floor-Plan Templets Stay Put

S. J. FECHT, *In Charge Methods and Time Study Department, Bauer & Black Division of the Kendall Company, Chicago*

Revising factory layouts necessitates considerable shifting of templets on the floor plan. If the templets are held in place by pins, as they usually are, the plan sheet must be backed by a wood board and is rather awkward to carry around or cover up. Furthermore, pin-held templets tend to swivel around and are difficult to reposition.

These difficulties may be overcome by using heavy paper templets and applying to the underside of each a drop or two of rubber mass solution. This solution may be made by putting a strip of surgical adhesive tape in a small bottle filled with carbon tetrachloride and allowing the two to stand until the solvent has dissolved some of the rubber mass. After the solution has been applied to the templets the solvent evaporates, leaving a sticky mass which will hold them in place on the plan.

This method of keeping the templets in position permits the plan to be removed from the board and carried around conveniently without disturbing them. Also, templets may easily be moved to a new position.

Special Notice

$15 will be paid for the best Operating Short submitted during the month of November. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

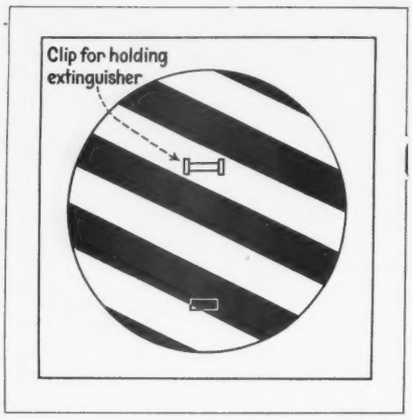
So You Won't Forget Where The Fire Extinguisher Is

EMIL J. NOVAK, *Omaha, Neb.*

Some means of making it easy to find fire extinguishers when they are needed is highly desirable. One of the simplest schemes involves mounting them against a background painted in special manner to call attention to their presence.

A large circle painted diagonally with broad black and white stripes, and forming the center of a white square, will stand out prominently against any background.

If desired the type of the extinguisher, or the name of the fluid in it, may be painted beneath the circle.



Clamping Rings Hold Split Pulley Firmly on Shaft

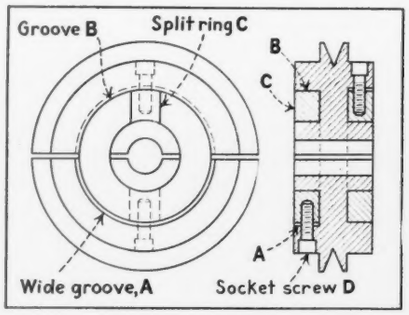
FRED COULTAS, *Leeds, England*

When it became necessary to place a grooved pulley on a crowded lineshaft one of special design had to be made up. The sketch shows how it was constructed and tightened on the shaft.

After the pulley had been turned up on a lathe, grooves *A* and *B* were cut in the sides. Groove *A* was made wider than *B* for a reason that will be explained later. Clamping rings, *C*, were next turned to fit groove *B*, and a segment cut out so they would pass over the shaft. The pulley was then sawed in two and drilled and counterbored for the socket screws *D*, which turn in tapped holes in the clamping rings.

When putting the pulley on the shaft the two halves were turned so as to bring one half of groove *A* and one half of groove *B* on each side. The split rings were slipped over the shaft and into the grooves, and the screws tightened to clamp the pulley firmly.

Although it might be thought that cutting the rings would weaken them



this is actually of no consequence because they are confined to the grooves and thus prevented from springing. Groove *A* was made wider than *B* to make the clamping action of the rings possible.

There are no projections on the pulley, it is well balanced, and the rings have sufficient clamping action to hold it rigidly in place.

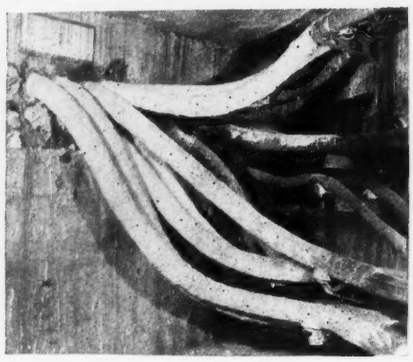
Determined to stop eye injuries, one plant reduced them from 103 in one year to 2 the next.

Wrapping Cables Prevents Fire Spreading

H. S. KNOWLTON, *New England Editorial Representative, Boston*

Because cable arcs produce severe heating which threatens in many instances to spread beyond the original trouble point, the Associated Factory Mutual Fire Insurance Companies, Boston, is advising increased attention to preventive measures in both old and new installations.

Selection of cables provided with flame-retardant outer coverings is recommended for general practice. Where old cables having combustible, exposed insulation are used the favored method of fireproofing is to wrap each cable with 2-in. asbestos tape applied with a 50 per cent lap and then thoroughly saturated with



RANGE *and* POWER

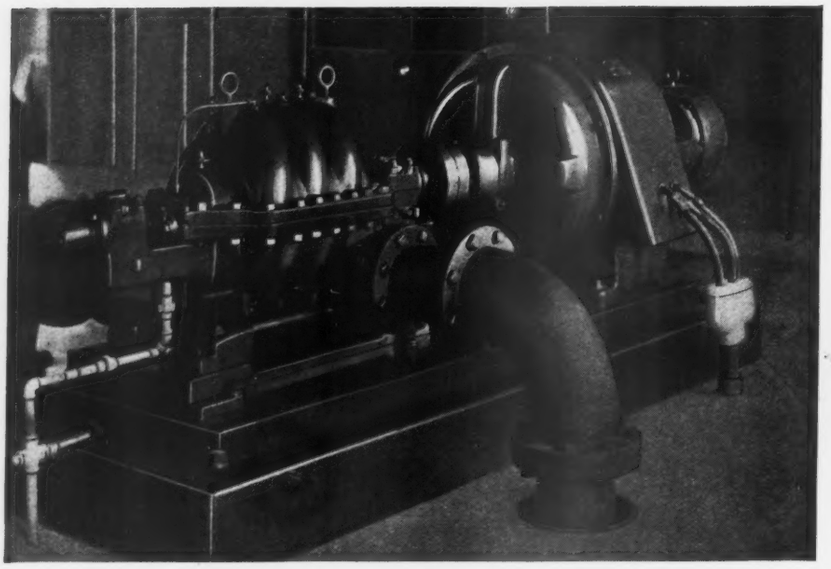
No bolted assembly is correctly designed *unless* it includes Helical Spring Washers... *adequate both in range and power* to keep parts tight.

SPRING WASHER INDUSTRY

616 WRIGLEY BLDG., CHICAGO, ILL.

ONLY A HELICAL SPRING WASHER HAS ADEQUATE RANGE OF

FOR WATER SUPPLY



Goulds Multi-Stage Centrifugal Pump delivering 700 g.p.m. at 300 ft. head at Hampden Reservoir, Reading, Pa. Hundreds of similar installations in all types of industrial plants are giving efficient trouble-free service.

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Because of high efficiency—the result of over half a century devoted to progressive improvement in design—because of fine materials, careful workmanship and durable construction, Goulds Multi-Stage Centrifugal Pumps have set unequalled records for low-cost-per-gallon pumping—for trouble-free service over long periods.

Available in capacities from 40 to 2000 g.p.m. for heads up to 850—feet—in bronze fitted, all iron and all bronze construction—these high efficiency pumps find wide application for general water supply, pressure service, circulating systems, unwatering and many other uses. Write for Bulletin No. 201 giving complete information.

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7129

a thin solution (sp. gr. 1.15) of silicate of soda.

In numerous cases such wrapping has confined the effects of short circuits or heavy grounds to very limited areas, allowing service to be restored quickly, if interrupted. The illustration shows the value of cable wrapping in a New England factory where an arc produced severe heating over an area about 4 ft. square, but since the arcing was confined to one or two cables which were in trouble, a disastrous shutdown was prevented.

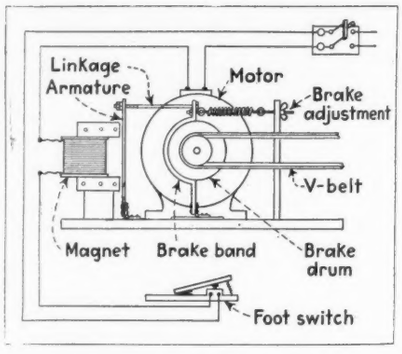
Wherever an operator's failure to set controls precisely may cause him to be injured, locking devices should be installed.

Automatic Magnetic Brake for Small Motor Drives

JACK BEATER, *Fort Myers, Fla.*

Practically instantaneous stopping is highly desirable on many small machines such as coil winders and counters. Where the turn count must be exact it is particularly advantageous to avoid run-over that must be unwound by hand. The simple brake shown in the illustration was installed on a small machine for winding motor coils and transformers.

The first step was to fit a small brake drum to the motor shaft. It



was turned from a flat pulley, and placed between the V-grooved drive pulley and the motor housing. Then a ¼-in. brass strip was formed to fit around one-half the circumference of the brake drum. The lower end of the brake shoe was hinged to the motor base. An eye was put in the upper end to receive the hook of the coil spring, which is adjustable for tension and holds the shoe tightly against the drum when the motor is not running.

In winding the brake release coil

COLONEL CLIPPER BACKS THE LINE

"In football," Colonel Clipper says,
"Fast backfield men are fine;
But backs, to reel off winning plays,
Must have a fast, strong *line*.

"Likewise, in factory or shop,
The *line's* your major need;
For output cannot hit the top
Unless your *belt-lines* speed.

"That's where my Clipper Hooks come in!
They lace belts supple, tight;
They grip 'em, hold 'em, make 'em spin,
Keep going, day and night.

"They outlast belts! They *hold* the pace
That clears your order books;
That's why three plants in four now lace
Their belts with Clipper Hooks."

Let Colonel Clipper back YOUR line!
Watch output figures "rise and shine"!

Clipper Belt Lacers and Belt Lacing Hooks, in all sizes, are stocked by your nearest mill supply jobber.

CLIPPER BELT LACER COMPANY, GRAND RAPIDS, MICH., U. S. A.

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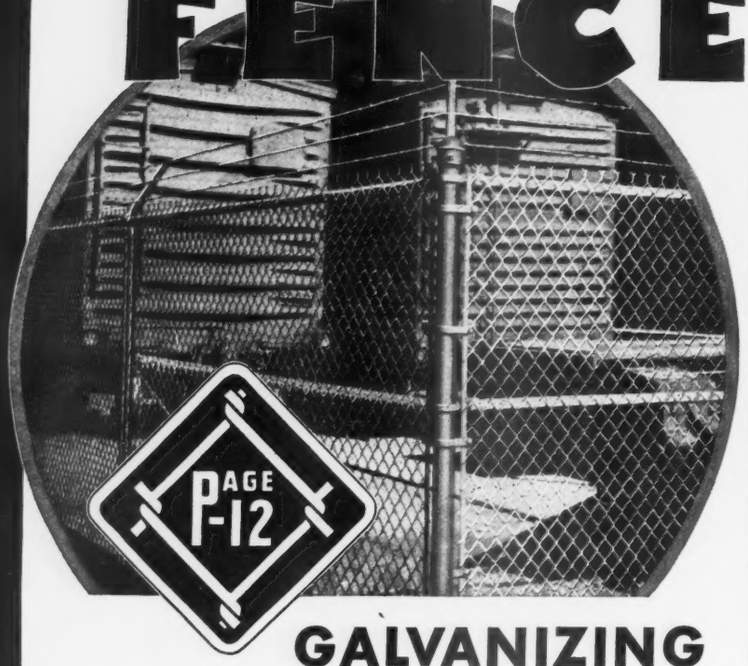
PAGE FENCE



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. . . double thick—longer life
. . . *at no extra cost!*

PAGE—America's first woven wire fence—since 1883—offers another great advance in fencing—P-12 Galvanizing.

PAGE P-12 Galvanized Fencing, identified by the label shown above, is guaranteed to withstand a minimum of 12 one-minute dips by the Preece Test—the accepted method of determining galvanizing uniformity and resistance to corrosion.

The 12-dip guarantee is the highest known to the industry. Most former fabrics would withstand less than half this number of dips. PAGE P-12 Galvanizing applies not only to fence fabric, but to fittings, top rail and wing-channel line posts as well. Specify PAGE P-12 fencing for double-thick galvanizing, longer fence life—*at no extra cost.*

5 SUPERIOR FENCE METALS

Since various atmospheric conditions require especially resistant metals, PAGE FENCE is offered in 5 superior metals to meet every condition in fencing—Page P-12 Copper-bearing Steel, Page-Armco Ingot Iron, Page-Alcoa Aluminum, Page-Allegheny Stainless Steel and Page genuine Wrought Iron. Metal best for location impartially recommended.

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Mail coupon below for nearest Page Fence Distributor's name and free copy of informative booklet, "Fence Facts."

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Please mail me new Free Booklet, "Fence Facts" and name of nearest associated Page Fence Distributor.

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Address.....

City.....*State*.....

a size of wire and number of turns were chosen that would pass the current required by the motor without undue resistance loss. As will be seen, this coil is connected in series with the motor.

The flat iron armature, hinged close to the poles of the U-shaped magnet, provides a maximum airgap of about $\frac{1}{8}$ in. When the coil is energized by the motor current, the armature is pulled against the magnet poles, the brake is released, and the motor runs freely.

A foot switch controlled by the operator starts the motor and releases the brake at the same instant When the switch is released the current to both motor and brake coil is cut off, and the coil spring immediately sets the brake.

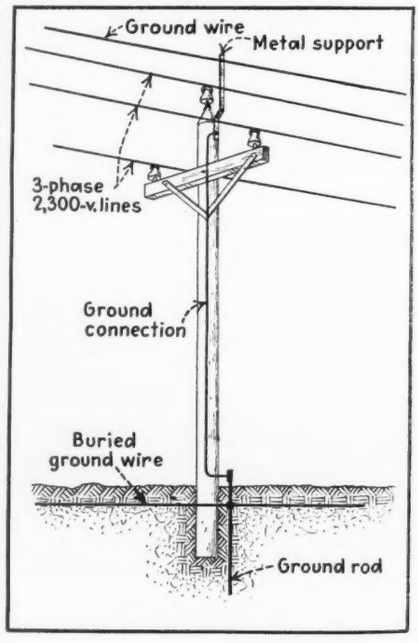
If desired, the magnet could be wired in parallel with the motor, with only a modest increase in operating current.

Don't stand in front of hand trucks being loaded. If the load is not placed squarely on the truck it may cause the truck to shoot forward.

Ground Wire Protects Pole Line from Lightning

S. H. COLEMAN, *Roanoke, Va.*

Overhead pole lines, alone or in conjunction with underground cables, are used in many plants for electrical distribution. One disadvantage of such lines is that lightning is likely to cause trouble in the



● With Farval on the job, no bearing will suffer from lack of lubrication. Because each point on all Farval-equipped machines is served positively, correctly, regularly—from one safe, central point.

With hand lubrication, remote bearings may be neglected or passed up altogether—but the Farval Centralized System reaches all and misses none.

The Farval System is a mechanical method of delivering clean lubricant from a central station under high pressure to a group of bearings, in exact, measured quantities. Operation is constant and positive, regardless of the number of bearings in the system, *and not a bearing is missed.*

Farval quickly pays for itself by eliminating loss of time in production; by reducing rejections of product due to faulty lubrication; by savings in power; by increased life of bearings and prolonged life of equipment.

Send for a nearby Farval Lubrication Engineer. He will bring valuable information and technical data. The Farval Corporation, 3256 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Co., Manufacturers of Automotive and Industrial Worm Gearing

FARVAL

CENTRALIZED SYSTEMS OF LUBRICATION

Special Delivery to Every Bearing

They Last Years Longer and Cut Handling Costs

Fairbanks

Hundreds of users are proving that hand truck costs can be cut—and cut plenty—with the Fairbanks. And no wonder! For they are designed to stand up under merciless punishment year-in-and-year-out.

The frame is practically wear proof because there are steel straps on the front and back. Handles can't work loose for they are part of the frame itself. You won't find the usual weakening mortises in the frame which are usually needed to fasten the crossbars.

About the only part subject to much wear is the nose iron—and that can be replaced cheaply by removing only six bolts. In fact, every part subject to excessive wear is replaceable.

Until you have seen and tried a Fairbanks Hand Truck, you don't know—you CAN'T know—what a tremendous improvement they are.

What's more, they eliminate noise and protect your floors from wear when equipped with Fairbanks No. 500 Rubber Tired Wheels.

Write now for Catalog 955.

THE FAIRBANKS CO.

Hand Trucks, Dart Unions, Valves and Wheelbarrows

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Boston, Pittsburgh — Distributors in Principal Cities

Factories: Binghamton, N. Y.; Rome, Ga.

way of burnouts and interruptions. Lightning arresters and surge-proof transformer equipment will do much to eliminate these difficulties, but where conditions are severe and delicate control equipment is involved, more comprehensive protection is often desirable.

In one large plant, for example, a three-phase, 2,300-volt pole line served an isolated pumping station for the water supply. All other plant distribution circuits were run underground. Lightning surges on this one line caused so much trouble both in the generating station and at the pumping plant that serious consideration was given to running this feeder underground. Due to the length, this would have been very costly.

Eventually it was decided to try one more method of protecting the overhead line. Accordingly, an overhead wire grounded at each pole to a buried counterpoise was installed, as shown in the sketch. Since the installation of this protection four years ago there has been no further trouble from lightning, and the idea of putting the line underground has been permanently abandoned.

Aluminum paint on copper busbars acts as a preservative when the busbars are subject to destructive atmospheric conditions.

Heat and Pressure Save Time in Altering Conveyor

K. B. HUMPHREY, *Sayreville, N. J.*

After the belt on a portable, motor-driven, coal conveyor wore out it was found that the spare belt was a fraction of an inch too wide to fit properly on the track. If it had been used, the wear on the edges would have been excessive and the useful life seriously shortened.

In order to avoid ordering another new belt, with the attendant delay, it was decided to widen the belt track by $\frac{1}{4}$ in.

The guides on the conveyor were fastened together with $\frac{3}{4}$-in. tie rods which were riveted in position. It was obvious that it would take considerable time to cut off the rods, turn down the ends, and then rivet them; so another scheme was worked out.

A small screw jack was placed between the belt guides and a slight pressure put on. Then a torch was used to heat the tie rods to a low

WIRE

Round—Flat—Half Round
Straightened and Cut
Shape Wire

HIGH CARBON SPRING
OIL TEMPERED — LOW CARBON
BASIC OR BESSEMER
WELDING WIRE RODS AND COILS

Sizes ½" to No. 40 WM Gauge (.007)—All Finishes

Wire for Practically All Purposes and Requirements also SCREEN WIRE CLOTH

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STOP CORROSIVE WEAR WITH PYROIL

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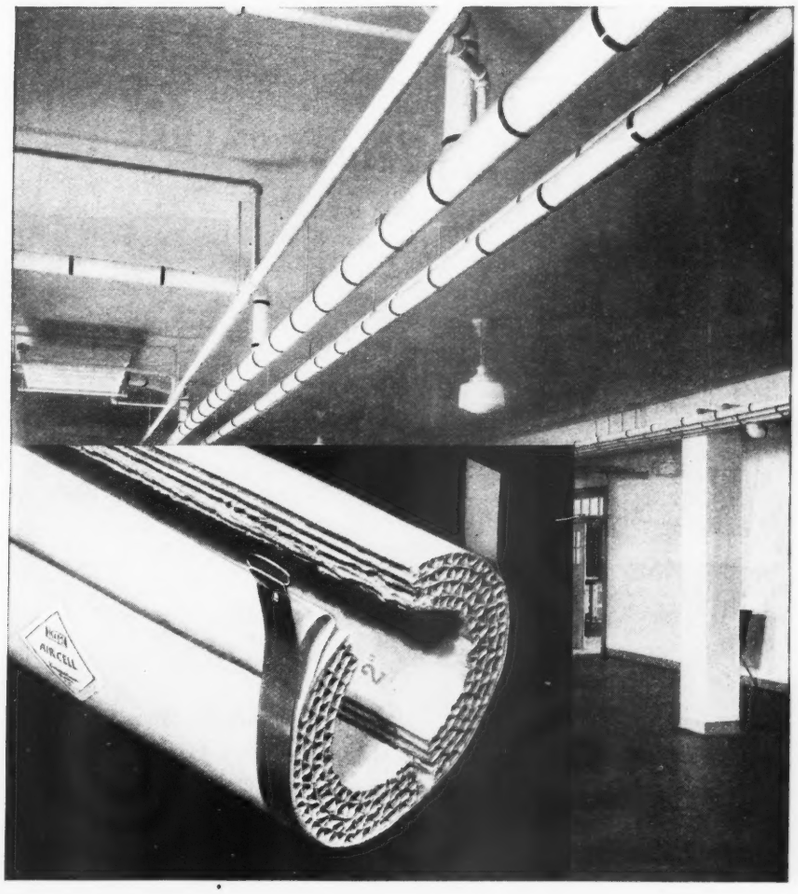
Corrosion cannot attack frictionized metal parts where Pyroil is used. Serious wear is stopped or offset. Costly shut downs and repairs avoided. Operation speeded, maintenance costs reduced. Pyroil reduces friction and temperatures. Often completely solves an otherwise insurmountable lubrication problem. Sold, used, the world over.

FREE LABORATORY COUNSEL

Write, telling us your particular problem. No obligation whatever. Manufactured and guaranteed by Pyroil Company, 504 LaFollette Ave., La Crosse, Wisconsin, U. S. A.

Unusual efficiency with low cost



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AIR CELL INSULATION

For temperatures up to 300° F., K & M Air Cell is one of the most satisfactory and inexpensive heat insulators you can use. Comes both as pipe insulation in sections, and in blocks. Made of alternate layers of corrugated and plain asbestos felt, firmly bonded together. It is supplied with a wrapper strip that acts as a hinge so that each section can be snapped right on the pipe.

Like every product in the K & M line, K & M Air Cell Insulation has behind it more than 60 years' experience in manufacturing asbestos and magnesia products. The most rigid quality-control assures you durability, uniformity and exceptional physical properties. The line is complete, and is specialized for the needs of each plant.

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Air Cell Insulations in sections and blocks • "Featherweight" 85% Magnesia Pipe Insulation, Blocks and Lagging • Asbestos Pipe Insulation in sections • Asbestos Insulation in sheets and blocks • Asbestos Insulating Cements • Asbestos Packings: rope, cord and sheet • Asbestos Gaskets, Gasket Tapes and Cloth • Friction Materials.

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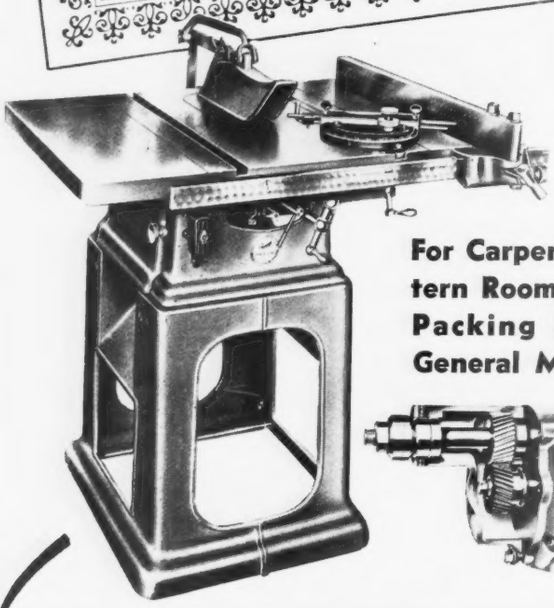
SPECIALIZING BRINGS VALUE!

Walker-Turner Co., Inc. offers this saw as proof that *precision* power tools can be built at a low price. Because we make small power tools *only*—because we have spent years in small tool research, engineering and production, you can safely buy this low priced saw and expect a full measure of accuracy and long service.



For Carpenter Shop, Pattern Room, Shipping and Packing Departments, General Maintenance . . .

Complete with ½ h.p. motor unit, cast iron stand, guard and splitter, "kick back pawls." (10" model with 1 h.p. motor — $140.25 complete)

DIRECT MOTOR DRIVE SAVES 40% POWER LOSS

On This Walker-Turner 8" Tilting Arbor Saw

$98.45

without extension tables

Full 2" cutting capacity and the new Walker-Turner Direct Motor Drive (geared) means that this saw will handle most of the lumber your departments use. The Tilting Arbor means that heavy or unwieldy pieces can be easily handled—the table is always horizontal. Makes angle cuts to 45°. Big table, with plenty of room in front of the blade. Precision ball bearings.

Many other quality features worth your close examination. Your nearby Walker-Turner dealer will supply you promptly, or send for descriptive literature. Walker-Turner Co., Inc., 33117 Berckman St., Plainfield, N. J.

WALKER-TURNER
***Engineered* POWER TOOLS**

red heat and the guides were spread the desired ¼ in. by stretching the rods. This operation was quickly performed on the six rods in turn and the conveyor was put back in service with little lost time.

One plant installed a diesel engine to drive a 16-kw. generator and a 10-ton ammonia compressor, reports savings of $110 per month.

Chain-Operated Switches Replaced Stop Buttons

GILBERT LINDGREN, *Electrical Foreman*
Hudson Valley Fuel Corporation
Troy, N. Y.

Usually the tendency in plants is to put in electrical methods of remote control, rather than mechanical. Recently we considered that it would be an advantage to reverse this process.

We operate a number of conveyors. Each was formerly equipped with twenty emergency stop buttons. Maintenance of these buttons and the long circuits to which they were connected was a sizable item in both time and expense.

These stop buttons have now been replaced by switches in the motor control circuit that are opened by pulling on light but strong chains suspended over and running along the length of the conveyors. This arrangement gives us just as good, perhaps better, protection under our conditions, and has reduced the work of the maintenance crew.

•

Electric Heat for Isolated Factory Office

SOURCE, *General Electric Co.*

How to heat a shop office without overwarming an adjacent shop by forcing the steam system above the

point of economical use? This office of a New England manufacturer is at one end of a building and has one radiator. It has a main section

5 MEN DO THE WORK OF 6

Tests show that on the average five men can do the work of six . . . not once in a while but every time, if they use Nicholson, Black Diamond or McCaffrey Files.

For the most exacting file tests ever devised show that these files are uniformly high in their ability to remove stock . . . that the performance of one represents faithfully the performance of thousands of dozens.

Now . . . while skilled labor shortage makes it necessary sometimes for five men to do the work of six, use the files that will help them do it *every time.* Nicholson, Black Diamond or McCaffrey . . . fastest cutting . . . uniformly high in performance. At Mill Supply Dealers'. Nicholson File Company, Providence, R. I., U. S. A.

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DURABILITY

FOR INDUSTRIAL FLOORS

●A permanently smooth and trouble-free floor surface may be secured *economically* by installing ACME FLOORSTEEL. The small mesh provides steel-rail support for truck wheels, preventing cracks, ruts and holes and the consequent high maintenance expense. The quiet, non-skid surface cannot wear any faster than the tough steel itself.

ACME FLOORSTEEL may be quickly and economically installed in new floors or in resurfacing present floors. Imbedded flush with the top surface in concrete or other suitable material, Floorsteel provides *permanent* protection. Furnished in standard one-piece rolls 25 ft. long, 47½" or 60" wide. Special sizes furnished at no extra cost.

A sample section and complete information will be forwarded for your inspection. Send the coupon today and find out how little ACME FLOORSTEEL costs in terms of years of trouble-free service.

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9x12 ft., an ell 4x12 ft., and a 7 ft. 8 in. ceiling.

A 5 kw., 220-volt electric air heater in a basement storeroom under the floor of the office provides the solution. Warm air is discharged into the office through a 10 x 12-in. register which is directly over the heater. Approximately 7 ft. distant is a cold-air return register. This arrangement provides for satisfactory circulation.

In the fall and spring, before it is necessary to start the steam system, electric heat suffices for the office, and in winter supplements the other heating.

Cold Bath Speeds Paraffin Coating Operation

SOURCE, *Maumee Color Company Maumee, Ohio*

To set the paraffin on coated paper packets for oleomargarine color, this concern has installed a cooling system that employs an air-cooled condensing unit. The unit provides water at 40 deg. in a trough immediately behind the paraffin bath through which the paper travels. With production often reaching 125,000 packets a day, it is necessary to maintain close temperature control so the paraffin will cool rapidly and the package sections will not stick together when packed.

This 1/3-hp. machine replaces 175 lb. of ice-melting per day. Mechanical refrigeration is used because with natural refrigeration bacteria growth often became objectionable in the bath. When the ice was low in the tank a mold formed which tainted the paraffin. This in turn tainted the color and produced a moldy taste in the oleomargarine when colored with powder so affected.

Questions and Answers

Setting Anchor Bolts in Old Foundation

A 150-ton ice machine is to be installed on the same concrete foundation used for the smaller machine which it replaces. We plan to enlarge the foundation by pouring more concrete around it, but it will be necessary to set some more anchor bolts in the old portion. How to place and anchor them for maximum strength is a problem that we have not yet solved. The old bolts are 1⅝ in. in diameter and extend from 3½ to 4 ft. into the foundation.

MAKES TRUCKS Glide!

PUT Bond's new 36-A Casters under your trucks and they'll glide across your floors like a champion skater across smooth ice. They'll take sharp bends with the ease of a veteran polo pony. Smooth handling, smooth swiveling are engineered into these casters.

This new caster is just one of the many that are Bond-designed for specific jobs. Get Bond's Truck Caster Catalog — the book that has shown hundreds how to fit the caster to the job. If you haven't time to dictate a note, just tear out this ad and write your name and address on the margin.

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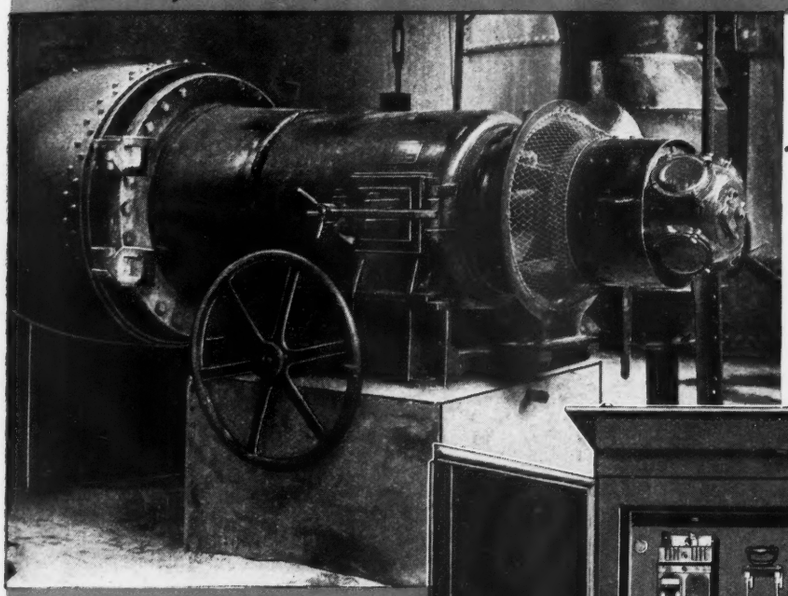
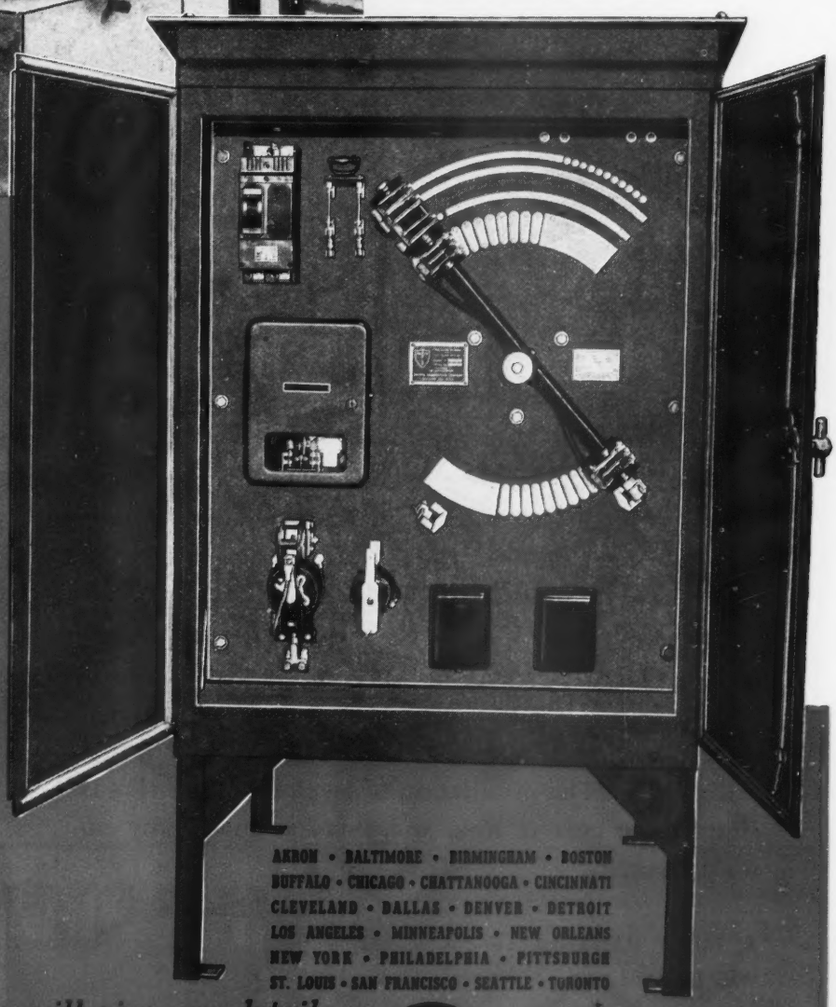
Bond REG U.S. PAT. OFF.
TRUCK CASTERS
Bond Power Transmitting Machinery delivers more power at less cost.

Freyn Design with Clark Control



Here's a Freyn-Design Pressure Burner installation in a Southern Steel Mill.

These burners are designed to use blast furnace gas in hot blast stoves, which, in turn, heat the air for the blast furnace. Gas is delivered to the nozzle which conducts it to the hot blast stove, after a motor-driven Vano blower forces air into the central portion of the nozzle for supporting combustion of the gas. A variable speed motor controls the required volume of air for the gas available.



And here's the Clark "3C" Automatic Control!

The regulator, at left center, determines the rate of gas flow, and also controls a small motor which drives the contact arm at the right. The contact arm controls the motor speed, because each gas flow or gas pressure demands a definite motor speed, and corresponding air volume.

Clark "3C" controls meet these and other exacting demands in all lines of industry. Precision in rugged construction — tested materials — modern engineering — careful supervision — high standards of workmanship — all contribute toward making "3C" control apparatus give dependable service for consistent continuous production.

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● There's safety for your men on walks of Steelcrete Expanded Metal. It is a diamond mesh with the strength of solid steel, non-skid, self-cleaning and offers no obstruction to light. This Steelcrete fabric is expanded from ¼″ plate with 2″ x 6″ diamonds; supplied in widths of 16¼″, 24¼″ and 48¼″—plain, painted or hot galvanized. Send measurements for complete estimate covering all materials including angle supports, railings, etc. The installation of Steelcrete cat walks is simple, the cost is low, and there is practically no maintenance.

A FULLY ILLUSTRATED CATALOG will be sent you on request, showing the application of Steelcrete Expanded Metal Fence to all types of commercial fence enclosures.

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We should like to have the recommendations of other readers on the best way to handle this job.—E.C.

ANSWER TO E. C.

WHEN SETTING a new gas engine on an old foundation it was found that some of the bolt holes came within half a diameter of the old ones, whereas others were 3 in. off.

It was realized that it would be difficult to punch holes adjacent to the old bolts, with a hammer and star drill; so a motor-driven bench drill was clamped into place about 3 ft. above the foundation surface. Instead of using an ordinary drill to pierce the concrete of the old base, a core drill such as is used in sampling rock formations was improvised.

This drill consisted of a 36-in. length of extra-heavy, 3-in. pipe, with the lower end cut into a series of saw-toothed notches, as shown. These formed teeth were faced with a hard metal, Stoodite, fused on with a torch to a depth of ⅛ in., which gave ample clearance for the drill and passage for the cooling water. Inside the upper end of the pipe was welded a 2-in. collar into which successive sections of 2-in. pipe notched to be driven by a dog on the drill-press collar could be screwed. Since the feed of the drillpress was 14 in., and the holes were to be drilled 36 in. deep, four drive nipples, one 6 in. long and the other three 12 in. long, with collars for connecting, were used for sinking the holes to the required depth.

A flow of water into the hole through the pipe and out around the bit washed the cuttings out and kept the cutter cool. The core left within the drill caused no trouble. If it broke into sections it merely piled up in the pipe. When it remained intact until the desired depth had been reached it was broken off after the drill had been withdrawn.

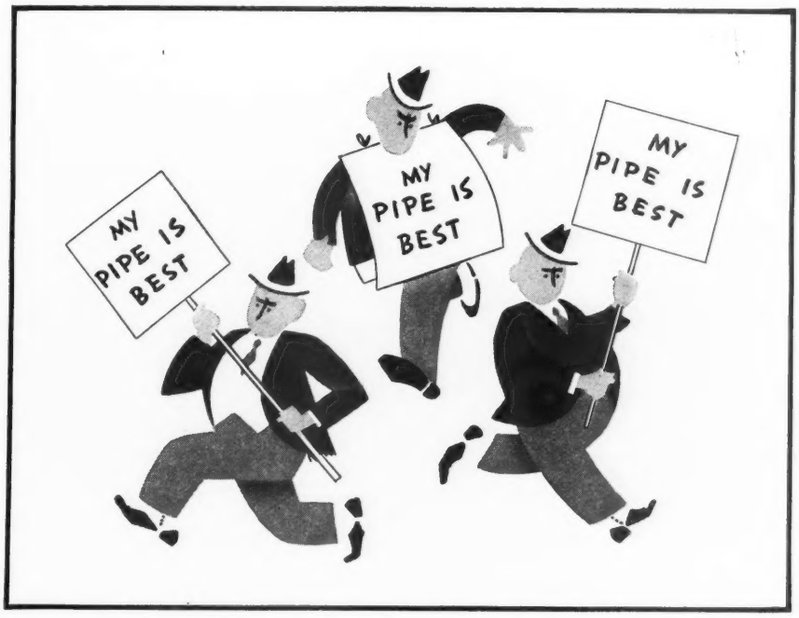
Where a new bolt nearly coincided with an old one, the drill was run down around the old bolt and the washer on the head was simply milled through by the hard-faced cutter.

After being drilled to the required depth the holes were filled with water, allowed to soak for 24 hr., and then blown out with compressed air and the bolts inserted. On this job the upper half of the bolts was incased in a section of heavy steam hose. The hole was filled with a neat cement grout.

Use of hose on the upper part of the bolts permitted slight lateral motion of the threaded end, for accurate registry with the holes in the engine bedplate. Where greater flexibility is desired, the rubber sheath may extend the full length of the bolt, using a heavy disk or washer at the lower end to give additional holding power.

A test made before the engine was set showed that a bolt in such a grout-filled hole as described would part under tension before the grout pulled loose.

ELTON STERRETT, *Longview, Tex.*



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I want to know more about your Research Service. Please send me my copy of your new booklet, "Now It Can Be Told."

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5

Sayings and Doings

How Job Insurance Works

Under the LaFollettes' leadership, Wisconsin enacted the first State Unemployment Compensation Act in this country. A conscious effort was made to be as fair as possible to employers. The law provides for individual employer reserves, which means that Wisconsin employers pay unemployment benefits only to their own workers—and not to the other fellow's.

Wisconsin employers are generally satisfied, and employers elsewhere are closely watching the Wisconsin law. Incidentally, it has served as a model for the Nebraska law, which differs from it on only one major point, and it has been copied in part by Indiana, Kentucky, South Dakota, Oregon, and Vermont.

The Wisconsin law became effective July 1, 1934, and benefits have been payable under it since July 1 of last year, the first payment having actually been made on Aug. 17, 1936. A worker unemployed for three weeks is entitled to one week's benefit for each four weeks he has worked. His average weekly earnings are computed by dividing his total wages during the calendar year by the number of weeks worked. This figure is then divided by two, since the law provides that the benefit rate shall be at least one-half the average weekly wage, and the resulting figure is lowered or raised to the next even dollar, depending upon whether it is more or less than $10. If it is $10.90, the worker receives a check for $10. If it is $9.10, he likewise receives $10.

The law differs from the Nebraska act by providing that a worker whose wage has fallen below his weekly average for three weeks is entitled to partial compensation. This tends to keep industry and commerce turning the wheels when they might otherwise curtail operations. Obviously, it is the least desirable part of the act from industry's point of view, and it is the one causing most grumbling.

An employer becomes subject to the act when he has employed eight or more persons over a period of 18 weeks. His contributions, amounting to 2% of his payroll, start from the beginning of that calendar year. Benefits are not payable to his employees, however, until he has been subject to the act for 24 months, and a reserve fund has been built up. The act now covers about 450,000 workers for 7,400 employers. The accounts of 4,300 employers have run the necessary 24 months.

Up to this week, 51,619 workers had received 175,956 benefit checks for $1,049,882.83, drawn from 2,437 employer accounts, and the net reserve fund balance was $24,729,627.84.

Current criticism turns chiefly on the point of partial unemployment compensation. But the big question is what would happen to their reserve funds in another depression. Raushenbush and the LaFollettes hope to have a fat reserve fund before then.

Business Week

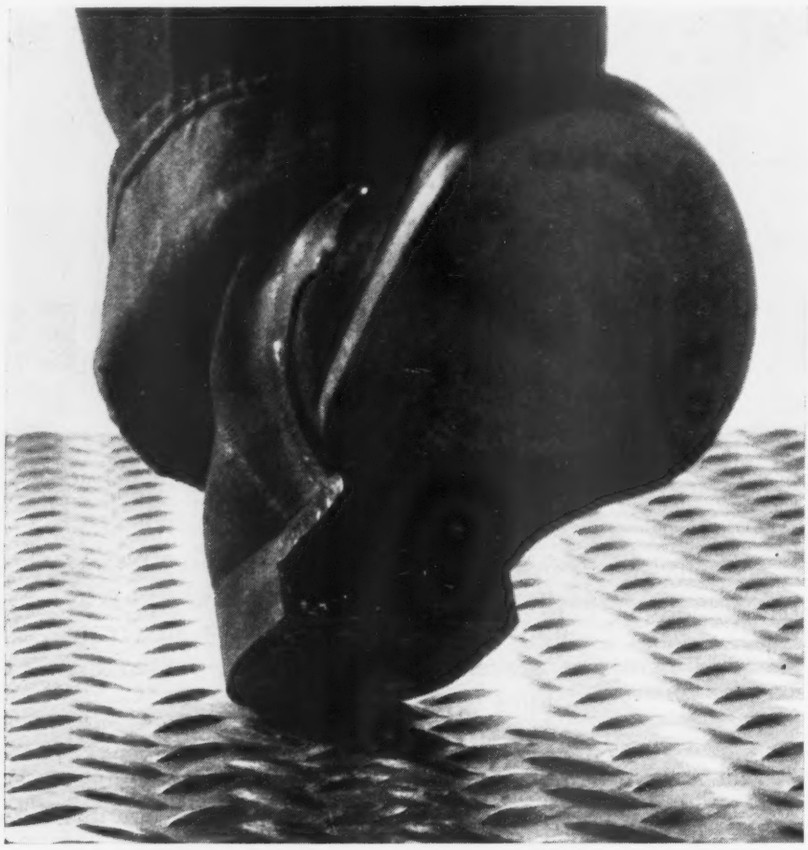
•

War on Dust and Fumes

A plan of medical and engineering research to combat industrial diseases due to dusts and fumes, potential peril to the health of more than a million workmen, is announced by the Air Hygiene Foundation.

This organization, with headquarters at Mellon Institute, Pittsburgh, is also opening a drive for broader support from industry to help this research. Approximately 170 firms, representing mining, metals, foundries, glass, refractories, ceramics and kindred industries are now affiliated with the Foundation, a non-profit, scientific organization.

Studies are to be made at Saranac Laboratory, Harvard School of Public Health, University of Pennsylvania Hospital, Singer Memorial Laboratory, and Mellon Institute, and work is to be



INLAND 4-WAY FLOOR PLATE
Means Safety Under Foot

Floors are part of the production equipment of your plant. Men and materials must move over them constantly. Making them safe against the most common of plant accidents (falls over level surfaces) also speeds up production—increases efficiency. Write for Inland's new interesting booklet on how and where Inland 4-Way Floor Plate fits into new plant construction and old plant repair and modernization.

SHEETS • STRIP • TIN PLATE • BARS • PLATES • STRUCTURALS • PILING • RAILS AND ACCESSORIES

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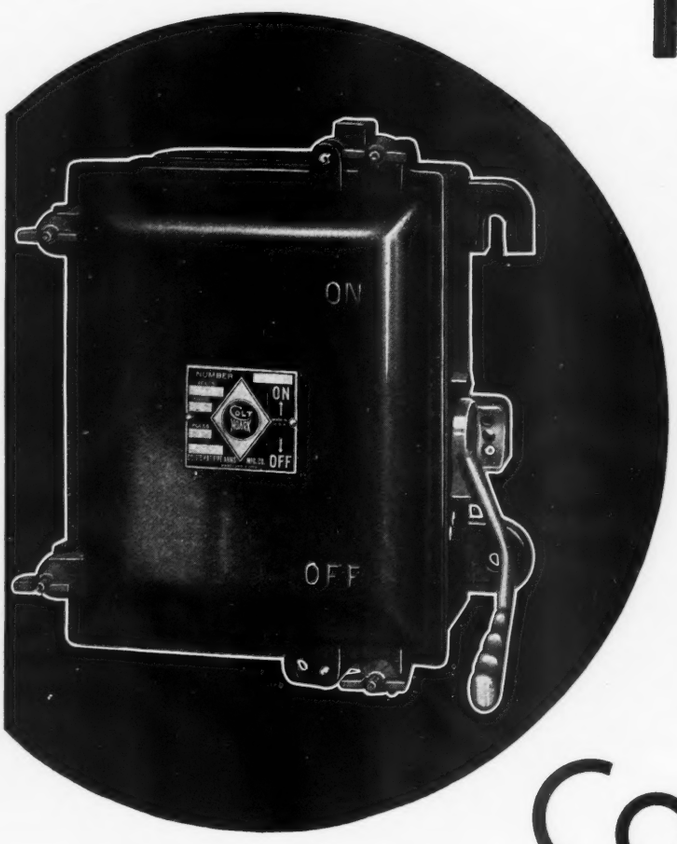
Built to TAME *the toughest job!*

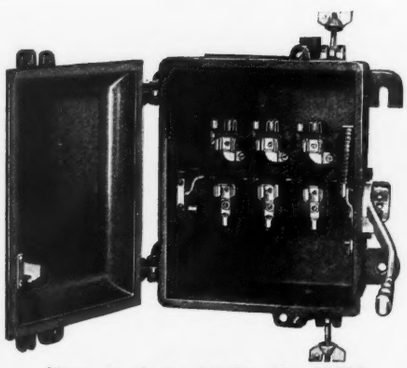


Dust, lint and water make life miserable for a Safety Switch . . . and so do steam and chemical vapors. It takes more than an ordinary switch to stand up under these conditions . . . and deliver dependable, trouble-free service year in and year out. But in these rugged Colt-Noark Weatherproof and Dust-tight switches you have a switch that is *designed* for just this type of abuse.

Next time you have a job that looks particularly tough, put in these hard-boiled Colt-Noarks . . . they'll tame it!

COLT NOARK

Dust Proof and Weatherproof Switches



Above is shown Catalog No. 99236, both open and closed. Note the rugged cabinet . . . the compact, simple construction of the switch unit . . . and the generous wiring space at both top and bottom.

AVAILABLE with fusible and non-fusible DUALBREAK mechanism . . . with quick-make, quick-break and interlocking covers. Either cast iron or cast aluminum cabinets . . . with covers securely fastened by extra heavy corrosion-proof eye-bolts and wing nuts. The metal handle operates in dust-tight bearings . . . and heavy rubber gaskets seal joints between the cover and the case. Tapped conduit holes are provided at top and bottom.

Heavy Duty Switch Mechanism . . . 230 and 575 Volts A. C. and 250 and 600 Volts D. C. Listed as standard by Underwriters' Laboratories, Inc. The mechanism is completely sealed . . . built for a lifetime of safe, dependable service. For full information write to

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undertaken in cooperation with the U. S. Bureau of Mines. The research will seek to discover:

1. Basic knowledge essential to determine the cause and prevention of diseases attributable to dusts and other industrial air pollutants.

2. What the employer must do to safeguard the health of his workmen and to protect himself against false damage claims.

3. Curtailment of the health hazards inherent in silica.

4. More practical information in the field of chest X-ray.

5. How to reduce the high pneumonia rate in smoky atmospheres.

Approximately 4,000,000 workmen are exposed to non-metallic mineral dusts in this country, according to U. S. Public Health Service estimates. Not all this number are exposed to injurious quantities. However, this figure does not include various other forms of air pollution, such as metallic and organic dusts and poisonous fumes and gases.

•

Men Over Forty?

On every hand we hear the encouraging fact that business is going ahead, production is on the increase, unemployment is being cut down, and that there is a decided scarcity of skilled labor. However, we have overlooked the fact that there is a new "forgotten man."

I am referring to a group of men between the ages of 40 and 65. The old-age security program will take care of the man when he reaches 65 provided he has been lucky enough to have earned an amount sufficient to make him eligible for a pension at a livable rate.

But on every hand we find men with years of valuable experience and training who, due to the personnel policies of the majority of our larger industries, are becoming outcasts merely because they have reached the ago of 40.

When a youngster first ventures into industry, he is met with the fact that no one can use him because of his inexperience. He finally manages somehow to find an opening, and gains experience and judgment. However, if he is unfortunate enough to lose his connection around the age of 40, no one wants him, regardless of his experience or anything else. This is indeed a serious matter and something will have to be done to take care of these men.

(This letter is published in the thought that other readers may care to comment, and that out of their comments may come some helpful solution to a very real problem.—Ed.)

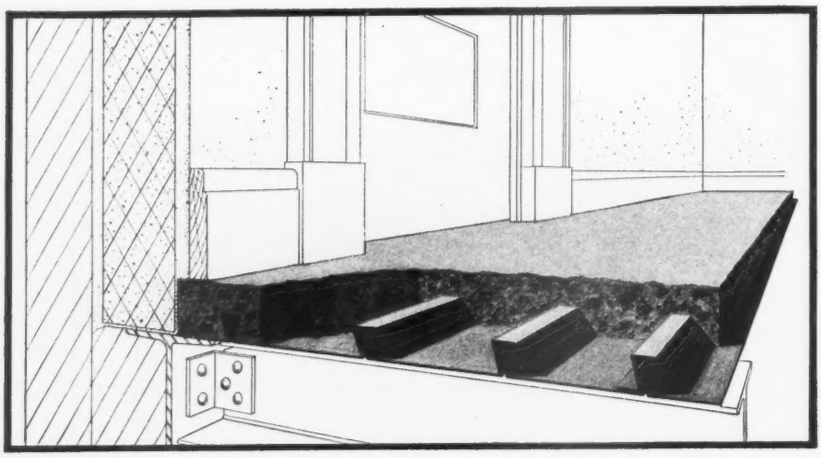
•

Legislation Against Age Discrimination

Bills attempting to legislate against age discrimination in employment have been introduced this year in six states: Illinois, Massachusetts, Minnesota, New York, Pennsylvania, and Texas. Thus far only the New York and Massachusetts bills have been enacted.

The former is a resolution creating a joint legislative committee of three members of the Senate and four members of the Assembly "to investigate and study the nature and effect of any economic conditions or statutory provisions which may tend to produce unfair, unequitable or unlawful discrimination against those men and women who have reached the age of 40 or thereabouts in obtaining and retaining gainful and livable employment in public service and private industry; to investigate and study the extent to which age is a factor in determining the efficiency of men and women engaged in such public service and private industry in seeking employment therein; to check the findings of previous investigations in the light of changed economic conditions; to investigate the effect of pension systems and group and workmen's compensation insurance upon the employment of the older person; and to suggest remedies to relieve or correct

(Continued on page 142)



This Combined Floor Form and Reinforcement

SAVES YOU TIME AND MONEY

Holorib Reinforcing Forms are permanent forms with strong, triangular ribs, "keyed" into the concrete, to provide all or part of the reinforcing.

They are quickly laid on the structural frame, affording an immediate platform and safety staging for other trades.

Concrete pouring can proceed at once in any part of the building, with no delays for removing, cleaning and re-erecting ordinary type forms . . . saving time and money.

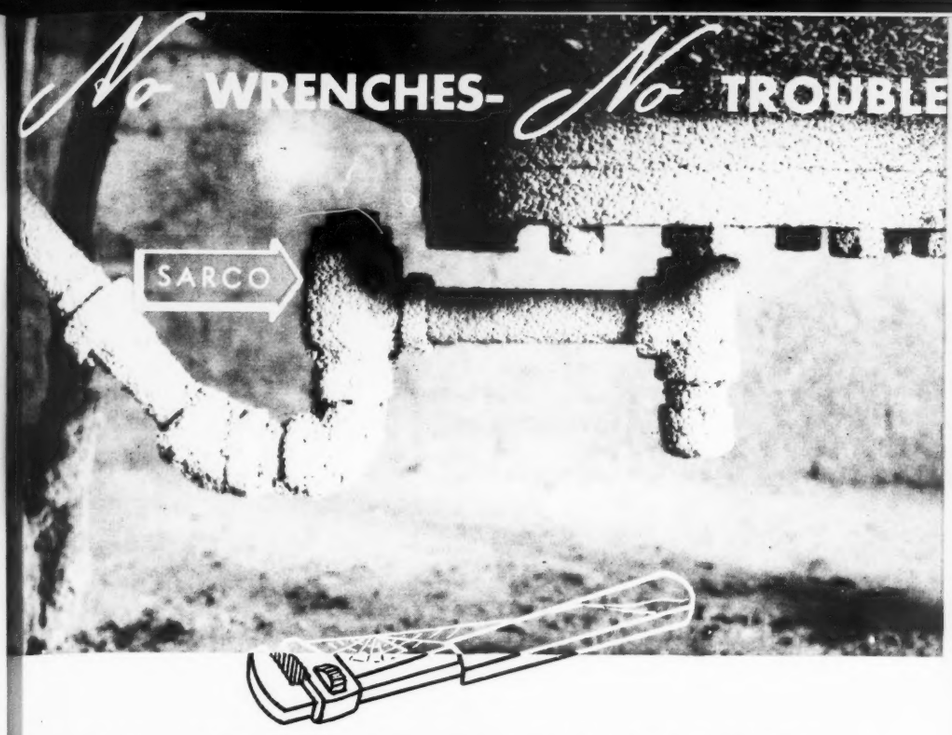
Holorib's tight joints prevent drippage . . . eliminate the cost of "cleaning up." The smooth under side of the steel sheets forms a clean, attractive ceiling.

A booklet of details and engineering data will be sent without obligation.

DETROIT STEEL PRODUCTS CO., 2258 E. GRAND BOULEVARD, DETROIT, MICH.

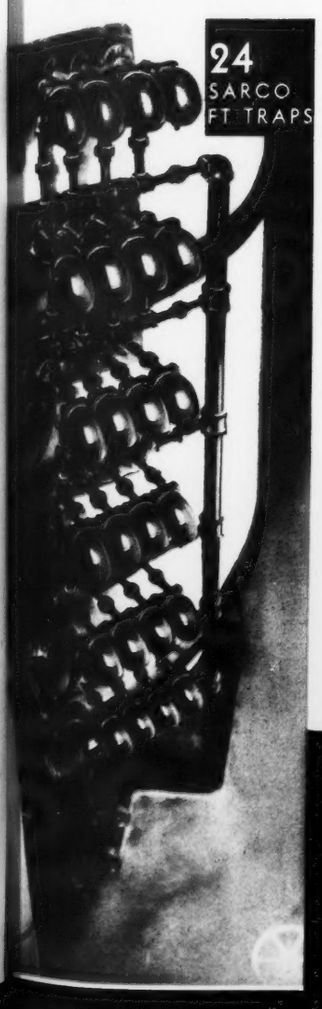
Fenestra HOLORIB

ROOF DECKS FLOOR FORMS



YOU DON'T NEED TO WATCH SARCO STEAM TRAPS

Here is the proof before your eyes! Above—a No. 9 thermostatic trap on a tilting kettle that obviously hasn't seen a wrench for months. Below 24 Sarco Float-thermostatic traps on one starch drier—where each and every trap must operate at all times!

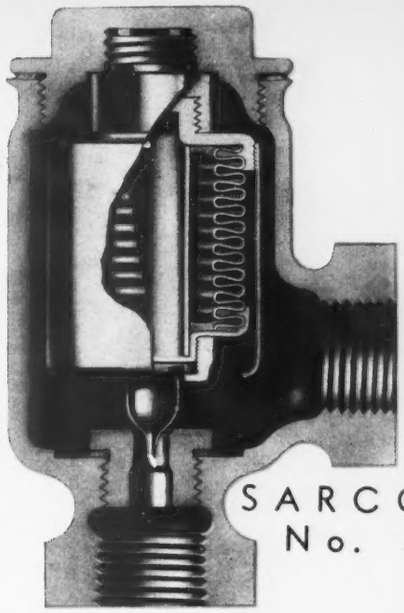


The reasons? First—a complete line to select from—the correct trap on every job. Second—a thermostatic element which is beyond question the outstanding achievement in the high pressure field. Third—Sarco men know industrial steam condensation and control problems.

Eighty percent of your requirements on high pressure will be met by one of the types of traps shown on this page. The other 20 percent is covered in our catalogs, and complete control systems are shown on the following page. You can safely standardize on Sarco—a company that can serve you on all these requirements. You can safely try Sarco on your hardest locations first.

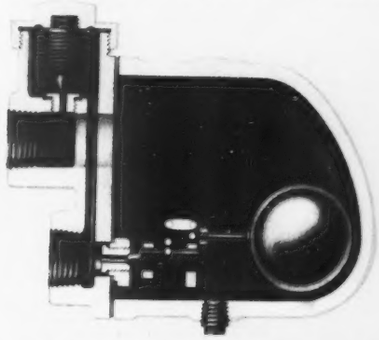
You cannot afford to continue to lose heat, steam, or production without looking into the outstanding service rendered by Sarco to industry during the past quarter century.

Ask for the new data book. Shows how to hook up all types of heating, air conditioning, and process equipment with suitable strainers, traps and controls. All sizes—all pressures.

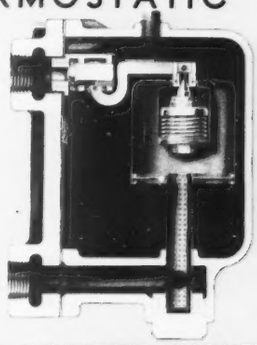


SARCO No. 9

HIGH PRESSURE THERMOSTATIC TRAP



SARCO FLOAT AND THERMOSTATIC TRAP



SARCO INVERTED BUCKET TRAP

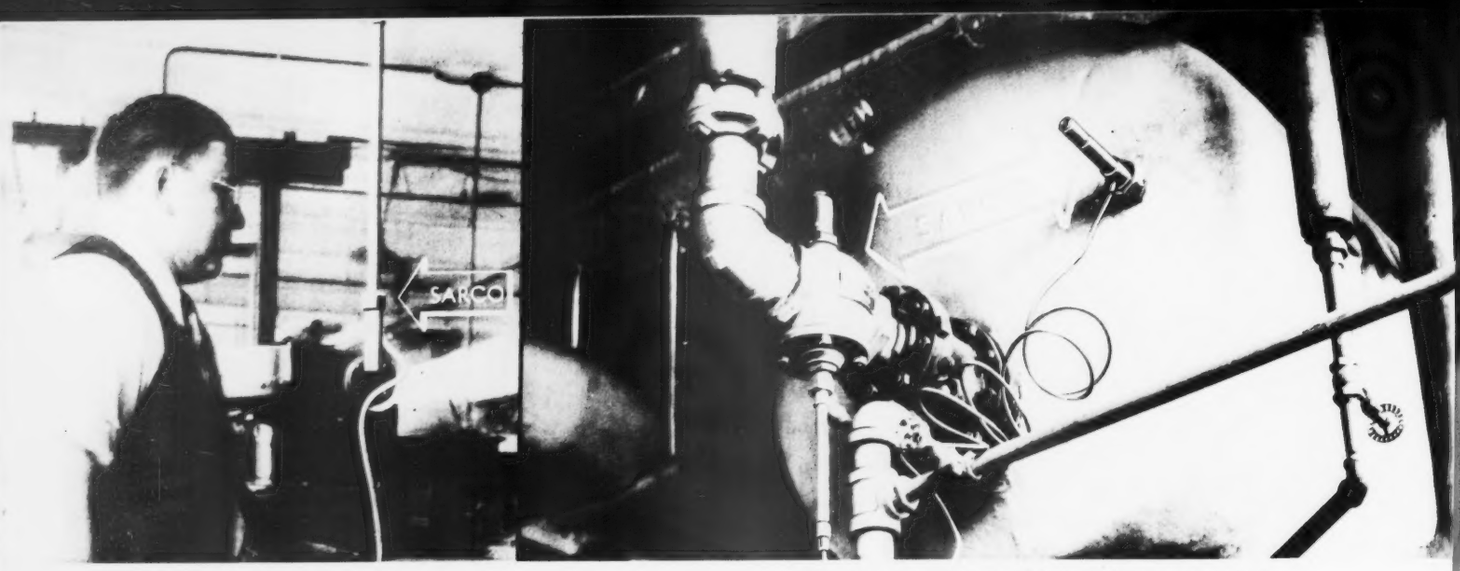
Ask FOR THIS NEW DATA BOOK

COMPLETE SYSTEMS FOR HEATING AND INDUSTRY

SARCO

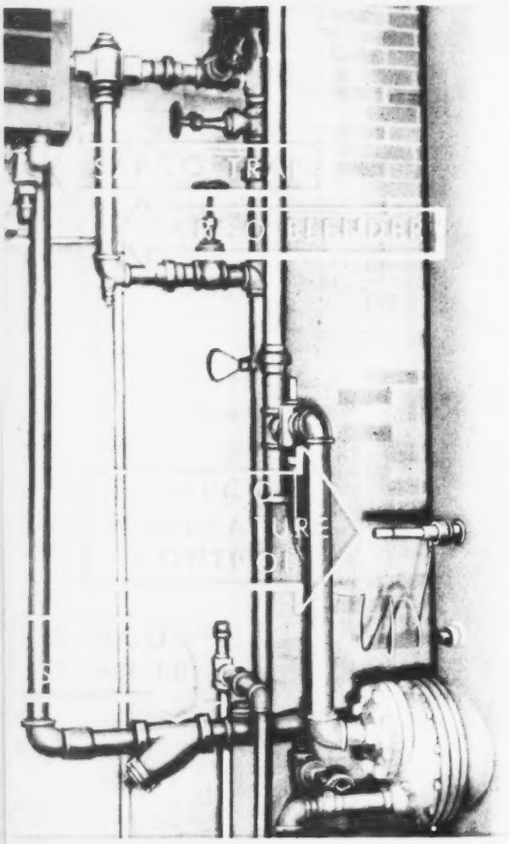
THERMOSTATIC, FLOAT AND BUCKET TRAPS, REGULATORS AND HEATING SPEC. .S

SARCO COMPANY, Inc., 183 MADISON AVENUE, NEW YORK, N. Y.

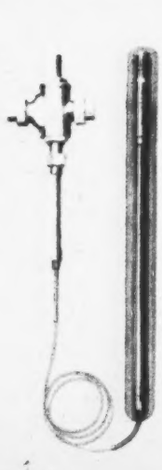


ONE OF A BATTERY OF FOUR HOT WATER TANKS
WITH SARCO TEMPERATURE CONTROL

PROCESS TANKS



TR-21 is standard for hot water storage tanks, blast heaters and many types of industrial process work.



KR-14 is designed for room control, dryers, kilns, refrigeration and cold storage.

SARCO HOT WATER CONTROLS

What does it cost in your plant when the hot water temperature is 10 degrees too high or too low? You will be surprised to find how little it will cost to keep it just right with Sarco Temperature Control.

SARCO PROCESS TANK CONTROLS

Incorrect temperatures can ruin a week's production in dyeing, cooking, plating, and a score of similar processes. Sarco Temperature Control often saves its cost in a month. It will protect the smooth flow of production for years and save its weight in gold by conserving your fuel supply.
Installed anywhere—any process—any size.

SARCO CONTROL FOR AIR

Driers of all kinds can be controlled by various forms of Sarco Traps and Control. Ideal for industrial air conditioning where reliability and accuracy are paramount. Ask for Catalog 52 on Sarco Control.

SARCO HOT WATER BLENDER

Takes hot and cold water right from your main lines and blends it from any temperatures you have coming in—to any temperature you select coming out. Reduces tank sizes and piping—prevents scalding accidents in wash rooms—saves fuel. Also ideal for temperature control of cooling coils by recirculation. Catalog 140.

LOW COST—PROCESS TANK CONTROL

Make production temperatures ***all-automatic*** by using Sarco Thermoton on jacketed kettles, cookers, metal washers, plating tanks, etc. Also used for regulating temperatures in storage tanks heated with steam coils. Catalog 146.

AND SARCO HEATING SPECIALTIES

Sarco furnishes a service that is unique in three respects. The controls illustrated above are the only controls for those purposes operated by liquid pressure. Both the controls and Sarco high pressure traps have the Sarco Bellows which cannot be duplicated. In addition Sarco has a complete line of traps, valves, strainers, and controls for all industrial heating pressures.

So, you can standardize your plant ***only with Sarco.*** Get the advantages of Sarco and Standardization at one operation with one company to contact and to be held responsible.

COMPLETE SYSTEMS FOR HEATING AND INDUSTRY

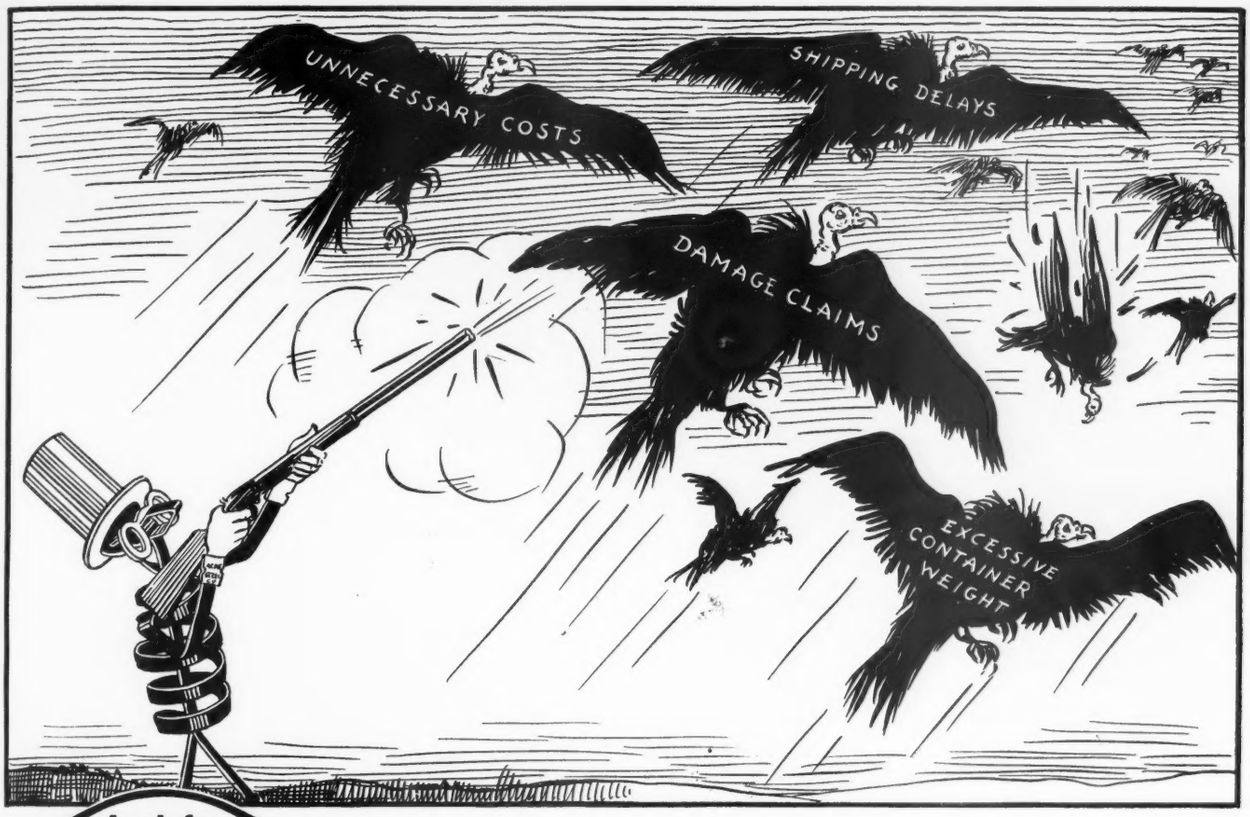
SARCO

REPRESENTATIVES IN ALL PRINCIPAL CITIES

THERMOSTATIC, FLOAT AND BUCKET TRAPS, REGULATORS AND HEATING SPECIALTIES

SARCO COMPANY, Inc., 183 MADISON AVENUE, NEW YORK, N

COST VULTURES LEAVE



WHEN Doc. *Steelstrap* GETS ON THE JOB

● The scavengers which feast on dead shipping weight, damage, pilferage, slow packing and shipping, thrive in many plants. But they starve to death after Doc. Steelstrap has been called in. A careful and expert diagnosis followed by the proper application of Acme Steelstrap eliminates them entirely.

Hundreds of concerns are making important savings in their shipping costs by using the modern Acme Steelstrap method. Savings amounting to more than 33% are not uncommon.

The application of Acme Steelstrap to *your* carton, box, bundle or crate will make possible reductions in materials, weight, labor and time. And you will receive the benefit of the consequent savings in dollars. Let Doc. Steelstrap help you hunt and eliminate the cost vultures which may be devouring part of your profits. Send the coupon for full particulars.

Get your copy of the book giving complete information about reducing shipping costs with Acme Steelstrap. It contains comparative cost figures, typical treatments and results. Mail the coupon for "My Second Strap-Book" today.

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*Name*_____

*Address*_____

*City*_____ *State*_____

(*Continued from page* 138)

the causes thereof." A report to the legislature not later than February 1, 1938 is called for.

The Massachusetts act provides that it shall be against public policy to dismiss or refuse to employ a person because he is 45 years of age or over. provided he is not 65 years of age. It empowers the Commissioner of Labor and Industries to investigate all complaints and ascertain the ages of persons employed. If the Commissioner finds complaints justified, he may publish the name of the employer as violating the act, after notice and hearing. Employers are required to keep age records.

Arc Welding Progress

True to the predictions that were made for it a decade ago, the electric arc welding process has been making tremendous strides in extending its fields of usefulness. The growth in volume in the past five years is clearly shown by the National Electrical Manufacturers Association reports of electric welding wire consumption, from 18.8 millions of pounds in 1932 to 111 millions in 1936.

That this progress is not all due to the general revival of industrial activity is shown by the steady increase in volume of consumption in the early thirties, before real revival began.

A more graphic proof is the increasing amount of electrodes being used for each ingot ton of steel poured. In 1932 the figure was 1.4 lb. of electrode for each ingot ton; in 1936 this figure had reached 2.4 lb. an increase of 71 per cent.

•

Letters from the Editor

•

Dear Mr. S———:

Upon returning from a trip, I find your letter of the ——— in which you compliment *Factory* on its editorials and articles relating to labor conditions. I am of course very much gratified. It is quite comforting to know that I am receiving the support of the men in industry who have to meet payrolls—something that most of our lawmakers and theorists never have had to do.

My chief concern of course is that all of our national experiments, looking toward raising purchasing power and standard of living by legislative action, may fall flat during some period of natural depression, with the result that we shall be at least as badly off as we were in 1932 and '33.

What is lost sight of is that all the legislative proposals up to date can do nothing more than redistribute existing wealth, represented by goods and services. The only way we can have a higher standard of living is to create more wealth.

If it were possible to legislate purchasing power, why stop at 40 cents an hour? Why not make it a dollar an hour? And then legislate additional purchasing power into the hands of all the gainfully employed. Of course, when put on that basis, the proposal is obviously fallacious. When put on the minimum wage and collective bargaining bases, it appears plausible and is a very good vote-getter.

You will excuse me for turning this acknowledgment of your letter into an editorial, but I feel very strongly about the situation.

Dear Mr. H———:

You can buy aptitude tests from the C. H. Stoelting Company, 414 N. Homan Avenue, Chicago, Ill. These are tests that were developed by a number of industrial concerns, and I am sure that, properly applied, you will find that some of them may fulfill your requirements. Most of our good friends in this field agree with us, however, that it is not always advisable to apply tests that do not have a close relationship to the specific job for which the applicants are being hired.

I wonder if you are familiar with

View from Motor Control Room looking out toward testing machine and operator's control panel and showing m-g set and EC&M Unit-type, Automatic Synchronous Starter.

WHEN the American Brake Shoe and Foundry Company designed their new Brake-Shoe Testing Machine to duplicate modern train operating conditions, they selected EC&M Control Equipment.

They made this selection because of the many advantages they recognized in this totally-enclosed, completely wired, unit-type control . . . erection expedited by the assembled construction . . . safety and compactness with no live parts exposed . . . attractive appearance in keeping with the modern design of their new testing laboratory.

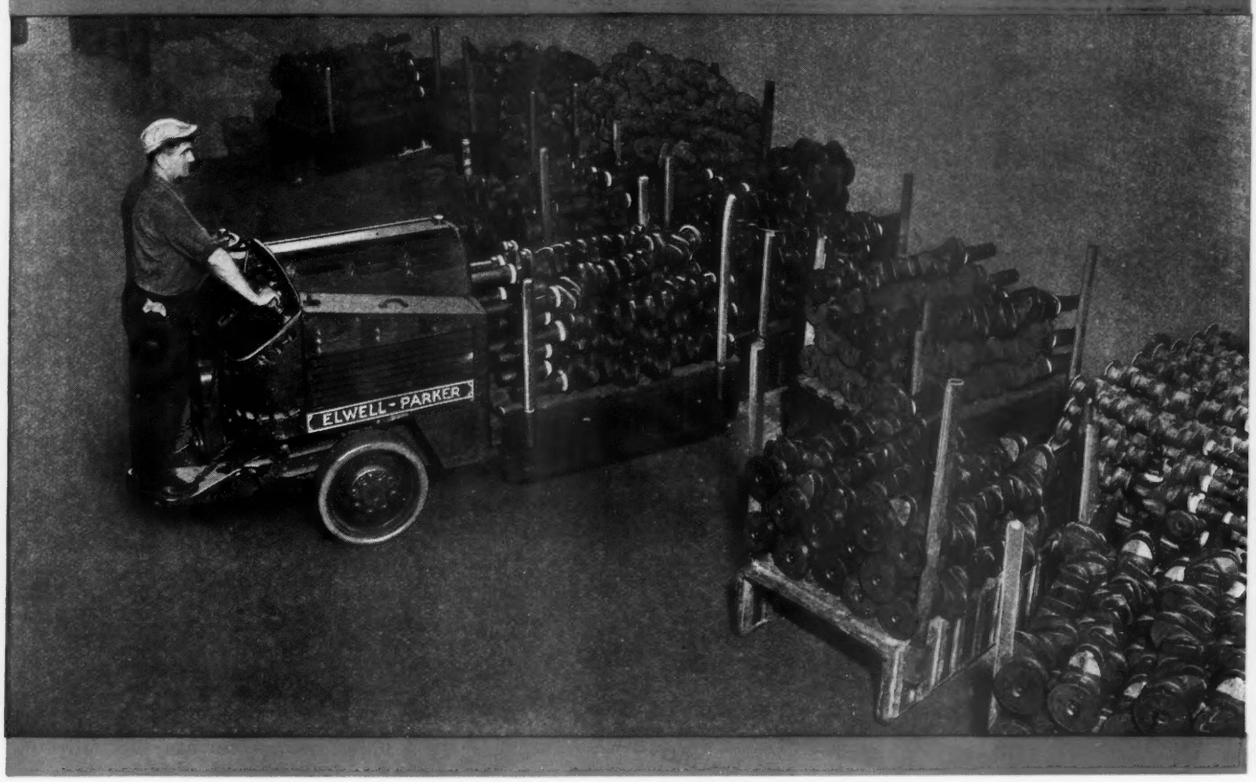
This is a typical example of the EC&M attractive, unit-type design which provides quick, low-cost installation. When selecting motor control or when purchasing machines, it pays to specify EC&M Control. The Electric Controller & Mfg. Co., Cleveland, Ohio.

The EC&M 200 HP, 4000 Volt Reactor, Synchronous Starter. This unit is complete with self-contained pot-heads, disconnect switches, meters and automatic field switching mechanism which is located in the lower compartment of the front cubicle.

THE ELECTRIC CONTROLLER & MFG. CO. E&M CLEVELAND, OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

HALF THE COST OF MANUFACTURING MAY BE *Wasted*



• • • • IN *Load Transportation*

Here is a perfect example of well-planned, cost-saving transportation of heavy loads at high speed, in which the Elwell-Parker System reduces the cost of materials handling to the minimum.

Half the cost of manufacturing not only may be wasted but sometimes actually *is* wasted through failure to plan suitable load-transportation methods under changing conditions, but The Ohio Crankshaft Company has proven that economy and speed move together—with resulting profit.

The Company keeps its materials—crankshafts on skids, load weight 2½ tons—steadily on the move, without either keeping machines waiting for parts or piling up and blockading aisles.

You, too, can keep transportation costs so low that a year's savings over previous methods will usually pay for the Elwell-Parkers.

An Elwell-Parker Engineer will show you how. The Elwell-Parker Electric Company, 4323 St. Clair Avenue, Cleveland, Ohio.

New Type **ELWELL·PARKER** *Trucks*

ESTABLISHED 1893 • BUILDING POWER INDUSTRIAL TRUCKS SINCE 1906

the articles by Dr. Drake that appeared in *Factory* in June and August of this year. Just in case you are not, I am sending tear sheets of both. We have long been familiar with the work that Drake has been doing at the Eagle Pencil Company, and believe that his work there constitutes a real contribution to current management practice.

We also have an article in the house on the application of aptitude tests to the selection of inspectors, written by a man who assisted Drake on the Eagle Pencil job. We expect to publish it in December, and I have no doubt you will find it illuminating. Drake, by the way, will be very glad to answer any questions you may have concerning his tests or concerning any feature of the work you apparently are about to attempt.

There have been a number of books in recent years that touch on industrial testing. The best of them, I think, are "Industrial Psychology," and "The Science of Work," both by Morris S. Viteles. These books are published by W. W. Norton Co., 70 Fifth Ave., New York City, and the prices are $5.50 and $3.75 respectively. Then of course there is the always popular book by Johnson O'Connor, "Born That Way," which is published by Williams & Wilkins, Mt. Royal and Guilford Aves., Baltimore, Md., and costs $2.

Dear Mr. B————:

In reply to your inquiry concerning material in pamphlet form on "Problems in Receiving and Checking Material" and "Stock Chasing and Its Relation to Production Costs," we are glad to send you copies of two special supplements to *Factory* that were published in the June and August 1935 issues. One is on Inventory Control; the other on Production Control. Both I think, will be useful to you. At any rate, they constitute the only material in pamphlet form that we have available on the subjects in which you are interested.

Of course if you want to make a more complete investigation in these fields you might do well to get a copy of the *Bibliography of Management Literature*, published by the American Society of Mechanical Engineers, 29 West 39th Street, New York City, (price $2). In it you will find literally dozens of references to articles in the above fields. I have no doubt you will find most of the articles referred to in your public library.

WEBB
Conveyors
SAY IT
WITH Savings
Wherever there is material to be moved in manufacturing—there is an opportunity to lower production costs and increase volume and employment by installing Webb Equipment. The Jervis B. Webb Company build and furnish conveyors for every conceivable use—and the experience of leading manufacturers, the world over, has shown these benefits invariably result.
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OVEN CONVEYOR
GRAVITY CONVEYOR
WEBB

What Protection With Control?

(Continued from page 89)

failure and shutdown, thus giving low-voltage release.

The choice between low-voltage protection and low-voltage release should not depend on the overload trip device, but the latter does, and must, bear a certain relationship to the former. An overload trip with automatic reset can be used only with low-voltage protection, whereas a trip with latch-out hand reset must be used with low-voltage release because removal of an overload by means of a control which can immediately restart will cause a rapid pumping action between start and trip which will continue so long as the overload persists, and soon destroy the equipment. This relationship is usually incidental, however, to the choice between low-voltage and low-voltage release, which depends on other considerations.

Low-voltage protection is desirable wherever a motor requires starting resistance to be cut out as it increases in speed. Otherwise, upon the return of line voltage after failure the motor might be unprotected by its starting resistance because the starting box or drum handle was still in the running position.

This form of protection is also desirable wherever the load is put on the motor after it is up to speed. For example, a lathe tool fed in slowly by the operator would be in position to be broken if the lathe

ONE-PIECE OR MILLED-AND-GROUND COPPER PARTS

. . . REDUCES HEATING IN

Westinghouse DE-ION Safety Switches

● The keynote of every feature you will find in Westinghouse Safety Switches is SIMPLICITY. By reducing every detail to its most elementary terms, Westinghouse engineers add years of useful life, cut maintenance costs to the vanishing point.

Bases are of one-piece non-carbonizing composition. One-piece copper parts on switches rated 200 amperes and below are readily removable from the front, and do away with many possible sources of destructive heating. On switches 400 amperes and above, copper parts are of milled-and-ground construction, and are rear-connected. Complete base assembly is removable from the front. Inspection is a matter of merely opening the cabinet.

Another simple, though exclusive advantage lies in the Diamond-Pointed Break Jaw and Extended Blade. It confines beading to areas which fall *outside* the contact surfaces when the switch is closed. Further protection to working parts in high-voltage types is supplied by the famous Westinghouse "De-ion" Arc Quencher.

Westinghouse Safety Switches are available in all commercial sizes and ratings, Types A, C and D. For complete information, call your local: **Westinghouse Office Electrical Wholesaler Electrical Contractor Motor Dealer**

In the past, arcs have been broken by "stretching." The "De-ion" quencher on 575 and 600-volt Westinghouse switches confines, divides and extinguishes arcs instantly—obviously preventing concentration of burning heat on contacts or arc barriers. J 20304

Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

A SWITCH FOR EVERY PURPOSE . . . AND ★ MOTORS ★ "DE-ION" LINESTARTERS ★ NOFUZE CIRCUIT BREAKERS

THE
UNI-SPEED
The New Stromberg
TIME CLOCK

32% FASTER
FULLY AUTOMATIC
ONE-HAND OPERATION

• Cut down time losses in your business with Stromberg's new Uni-Speed Time Clock. It has the unique feature of easy one-hand operation—no time lost waiting in line to get on the job. The Uni-Speed is 32% *faster!* Its advantages are of benefit to both employee and employer.

Time card registrations are printed on the front of the card and are quickly and easily read—with clear and accurate printing. Time irregularities are spotlighted in red ink if desired.

The Uni-Speed will automatically take care of the varied requirements of any business, regardless of working hour schedules. It cuts much of timekeepers' routine work *in half!* Write for information. Ask about liberal trade-in allowance on your old Time Clock.

STROMBERG ELECTRIC COMPANY
231 West Erie Street, Chicago, Illinois
Stromberg Time Recorder Co. of Canada, Ltd.
284 King St., W., Toronto
SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES
Also Manufacturers of
Electric Job Recorders, Commercial and Advertising Clocks, and other Time Equipment

Electric Job Time Recorders

Cost records, to be worth anything, must be accurate. Stromberg Job Recorders provide an accurate yardstick on the efficiency of workers. They *cut down wasted time.* Electrically operated, foolproof, inexpensive to maintain—they belong in your cost system.

MAIL THIS COUPON TODAY!

(Paste on postcard if you desire)

STROMBERG ELECTRIC COMPANY
231 West Erie Street, Chicago, Illinois

Please send me illustrated booklet containing complete information on: (Check) The New Stromberg Uni-Speed Recorder ( ); Job Recorders ( ); Time Stamps ( ).

Firm Name _____
By _____
Street _____
City _____ *State* _____

started suddenly when line voltage returned after failure. Likewise, a plunger pump started on full motor speed with the water bypass open and then gradually loaded by manipulation of the valves should not be started suddenly against full water pressure lest something break or the motor be stalled and overheated, or tripped off by the overload.

Finally, low-voltage protection is necessary wherever failure of line voltage may cause an operator to jeopardize his own safety by tinkering with open machinery or belts to see why they stopped.

In view of the foregoing it might be asked whether low-voltage release is ever desirable; whether returning line voltage should ever be allowed to start a motor without supervision. However, an operator in a large office building or factory where totally inclosed centrifugal pumps are operated by float switches to keep the cellar dry or the roof tank full of water, or in a bakery where a valuable "bake" may be ruined by cooling of the ovens due to voltage failure, has no desire to watch some electric light until voltage returns, and then rush madly about the place starting every pump, feed water device, and temperature-controlled equipment.

Protects Equipment

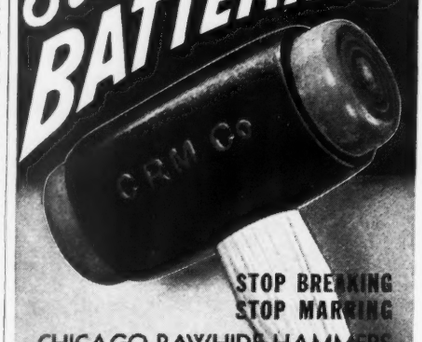
In fact, aside from the nuisance involved, it is obvious that if the equipment is automatically stopped and started by regulating devices it will not be harmed by having the line voltage go off and return due to some cause other than the regulator. Furthermore, if uniform pressures, temperatures, and water levels are to be maintained by regulators, low-voltage release is absolutely necessary. Otherwise, if low-voltage protection were employed when the regulator shut the equipment down it could not start it up again.

In choosing controls, therefore, spring-return or maintained-position handles and pushbuttons should not be selected according to whim, space requirements, or price, but from the standpoint of whether protection against sudden restarting upon resumption of line voltage after failure is needed, or whether release upon voltage failure and purposeful restarting upon return to normalcy are required.

Not only should these points be given due consideration at the time of purchase, but if low-voltage release is chosen the motor, gears or belting, and load should be properly inclosed so that no one will be injured by the motor's unexpected restarting.

CHARAVAY
FANS
THE OLDEST NAME IN
PROPELLER - TYPE VENTILATION
for
• Plant Ventilation
• Man Cooling
• Materials Cooling
• Materials Drying
• Heat Dispersion
• Dust Control
• Fume Dispersion
• Air Circulation
• Home Ventilation
• Mine Ventilation
• Unit Heating
WRITE FOR FACTS!
HARTZELL
PROPELLER FAN CO.
ORIGINATORS OF
Propeller-Type Ventilation
WALNUT ROAD, PIQUA, OHIO
Sales-Engineering Offices Everywhere

Stop BATTERING



STOP BREAKING
STOP MARRING
CHICAGO RAWHIDE HAMMERS save finished surfaces, machinery and parts. They reduce spoilage and breakage, still speed up work for they permit powerful, accurate blows that get things done . . . *safe* blows that will not dent, batter or mar.
Permanent tools with smooth 1-piece malleable-iron heads (no threads to loosen).
Replaceable insert faces of tough coiled rawhide. Resilient (not rebounding) — will not split, crumble, or smear. They hold their balance, form and face.
7 sizes.

C/R CHICAGO Rawhide MFG. CO.
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TO THIS PLANT'S LIGHTING PROBLEM

Here is a book that should be helpful to every industrial plant — a complete manual of Wheeler equipment for getting better lighting. In this book you find the answers to industrial lighting problems. You find hundreds of different light-controlling reflectors — designed to give the greatest amount of useful light for all kinds of manufacturing — designed to increase production, to eliminate accident hazards — and to lower lighting maintenance.

Because no two plants — in fact, seldom two rooms — have the same lighting problems, *proper* lighting must be *planned*. So send for this manual and use it in your planning. And — if you want good sound advice or valuable assistance—take advantage of our engineering service — a complete service that includes planning, recommendations and blue print layouts. No obligation. Write or send coupon today.

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—and Dixon adds years to the life of the paint. The records prove it and the reasons are plain. Nine and ten years and more is a common useful life-span for Dixon's Industrial Silica Graphite Paint. These coatings owe their protective excellence to the qualities inherent in pigment and vehicle. Natural Flake Graphite is chemically inert and moisture repellent. Silica, combined and mined with the Graphite, adds specific gravity and hardness. Pure boiled linseed oil is the finest vehicle known. The result is a paint that seals the surface in a sheath of overlapping flat, microscopic shingles that adhere with phenomenal tenacity and withstand all inimical influences to an extent insuring lowest paint cost per square-foot-year.

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Modern

from the wheels . . .
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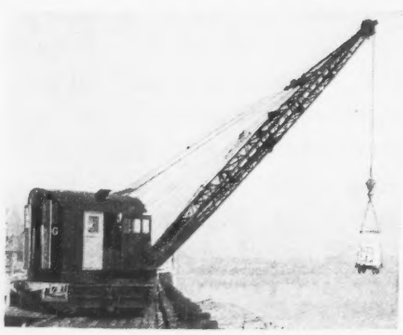

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Diesel, Gasoline or Electric Locomotive Cranes . . .

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BROWNING PRODUCTS
Diesel Gasoline Steam Electric

A Case in British Labor Relations

(*Continued from page* 57)

headquarters, rather than with the local officers of the unions. Naturally, the executive council and chief officials of the unions are better qualified—and, broadly speaking, the curve of sweet reasonableness rises steeply as one approaches the higher hierarchy.

All I have said about our relations with trade unions has arisen from what I described as the first implication of our labor policy—that is, our attitude towards the wage question.

The second implication is that we should do all we can to increase the sense of security of the worker in his job and in his wage.

Apart from our commercial people's constant efforts to even out their demands on the production departments, our Staff Grade Plan is our outstanding contribution to this security sense. Under that scheme, every employee with 5 years' service is eligible to be put on staff conditions. These include a guaranteed minimum wage throughout the year, unless 4 weeks' notice is given to vary it or to terminate the contract; that guaranteed wage is paid during absence through sickness or accident up to 6 months.

Belied the Fears of Prophets

Our experience with this scheme has completely belied the fears of our pessimistic prophets that we would get a lot of malingering, and our intention to maintain it and even expand it is entirely justified by the response the workers have given in the form of intensified effort and cooperation.

We have also made a contribution towards the wage security of the general body of workers who are not on Staff Grade by protecting their weekly wage during the weeks when our six national bank holidays occur. We have undertaken that the intervention of one or more of these days in any week shall not operate to reduce the workers' normal wage for that week.

Our Pension Plan also contributes to the security sense; in addition to providing invalidity and old-age annuities, it provides generous cash payments if the worker loses his job through no fault of his own, or dies in harness.

There is no doubt at all in my mind that we must concentrate more and more on finding ways and means

SKILSAW IS A TIME AND MONEY SAVER IN EVERY INDUSTRY... ON EVERYDAY SAWING JOBS!

• Rips out 60 ft. of 3 in. old maple flooring in ten minutes! Cuts to pre-determined depth.

• Opens shipping cases quickly without damaging contents! SKILSAW saws through nails, resizes crating lumber.

• Cuts metal 10 times faster than a hacksaw! Cuts non-ferrous metals, lead, copper, lead-covered cable, steel, iron.

• Trims a door for hanging in 7 minutes! Cuts off strips no thicker than a plane-shaving.

• SKILSAW grooves smoothly for weather stripping, tanks, vats, etc., up to 3¾ in. wide.

• Saves time in cutting car bracing! SKILSAW is ideal for cutting lumber for blocking and bracing carload shipments.

BECAUSE it cuts 10 times faster than a hacksaw . . . because it goes to the job and reduces material handling . . . because it is convenient, economical, powerful—SKILSAW is used by the metal industries to save time and labor costs! It cuts lead tubes and sheets (up to 4 in. thick) in lead factories and branch warehouses. It sizes continuous cold-rolled sheets in mills. It cuts copper in tank factories. It cuts lead for acid baths in chemical plants.

SKILSAW is accepted in every industry as the leading portable electric handsaw because it is built stronger, will do more sawing jobs, *has more power in each of its nine models!* Works from any light socket. Cuts wood, metal, stone and compositions.

• See Skilsaw at Your Distributor's and Write for Our New Complete Catalog

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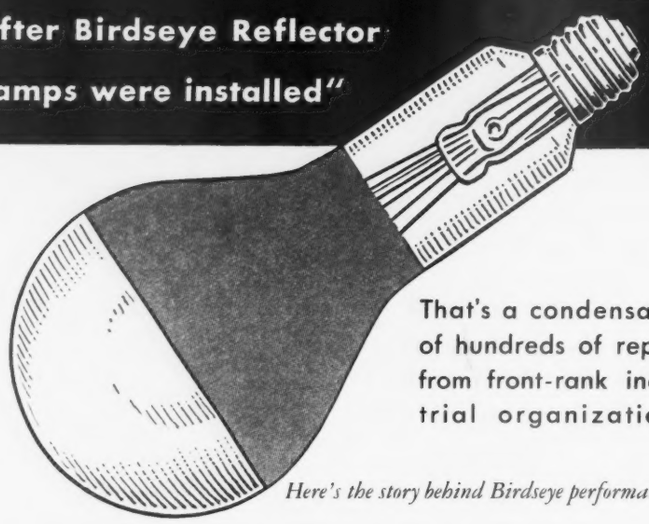
"LIGHTING LEVELS UP... MAINTENANCE COSTS DOWN

after Birdseye Reflector Lamps were installed"



That's a condensation of hundreds of reports from front-rank industrial organizations.

Here's the story behind Birdseye performance:

LAMP AND REFLECTOR A SINGLE UNIT

Birdseye Reflector Lamps are inside-silvered, making each lamp its own reflector. No separate reflectors, special wiring or auxiliary equipment is required. *That's why maintenance costs go down.*

EVERY RAY CONCENTRATED ON THE JOB

Filament at exact focal point—every watt turned into useful light—every ray thrown directly on the work plane—no absorption due to soiled or surface-worn reflectors. *That's why lighting levels go up.*

NO LONGER HIGH PRICED

Formerly known as "most expensive to buy—cheapest to own," Birdseye Reflector Lamps have been re-priced *downward* to comparative levels.

PROOF ON YOUR OWN PREMISES

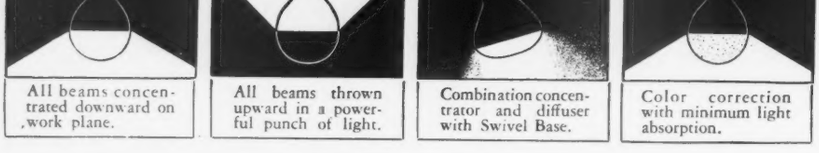
Make your own tests of Birdseye Reflector Lamps and you will be able to estimate the lighting economies they will bring to your plant. For full details and for complete engineering data, write: Birdseye Electric Co., 100 East 42nd Street, New York, N. Y.

BIRDSEYE REFLECTOR LAMPS

Inside-Silvered BIRDSEYE ELECTRIC CO. *Self-Reflecting*

100 East 42nd St. New York, N.Y.

Reg. U. S. Pat. Off. *Factory: Gloucester, Mass.*


DIRECT
All beams concentrated downward on work plane.
INDIRECT
All beams thrown upward in a powerful punch of light.
INTENSIFYING SPOTLITE
with Swivel Base
Combination concentrator and diffuser with Swivel Base.
BLUE SPRAY
Color correction with minimum light absorption.

to pay the worker a regular weekly wage throughout the period of his contract. It is one of the signs of the changed workman of 1937 that he is now alive to his need of this security for himself and his family, and we believe that any contribution we can make to that need will contribute also to the stability of our industrial and political system.

The third implication of our labor philosophy is the one which compels us to provide adequate channels of approach from the management to the men, and *vice versa*. We do this mainly by our Works Council Plan.

Three Parts to the Plan

This plan has three parts: (1) 55 works councils at the individual plants; (2) nine group councils consisting of delegates from works manufacturing the same or allied products—thus the Alkali Council, the Explosives Council, the Metal Council, etc.; (3) the Central Council, consisting of delegates from each of the group councils. The Works Manager is chairman of his works council; the Chairman of the Group Board is the chairman of the group council; and the Chairman of the Company, Lord McGowan, is chairman of the Central Council. The works councils meet monthly; each group council and the Central Council meets twice a year.

Every council is a 50/50 body—half management nominated by the company and half workers elected by secret ballot.

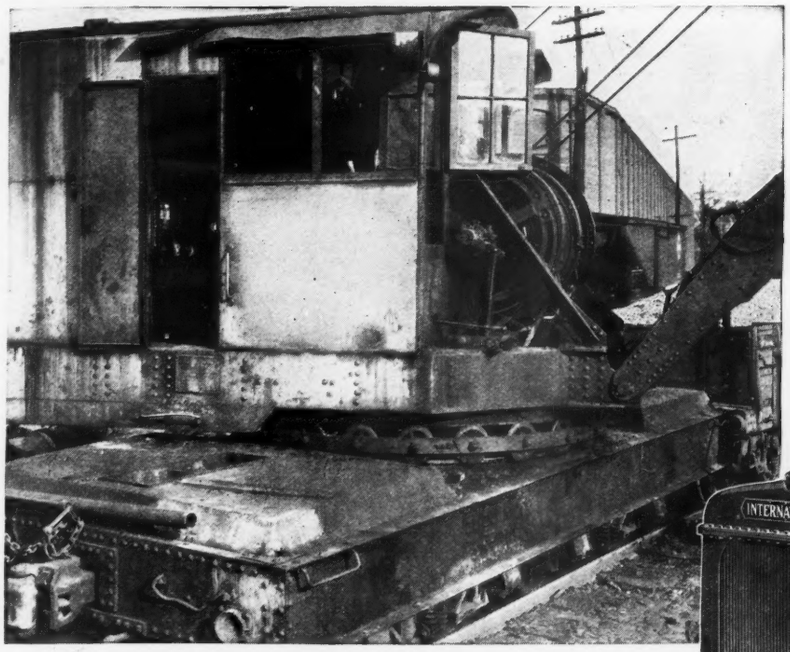
Company Affairs Aired

At each works council meeting, the chairman tells the members as much as he possibly can of the affairs of his plant—the state of the order book, any difficulties of competition, etc. He describes any new process or product, or explains what alterations are contemplated. The chairman of a group council does the same thing on a wider basis for his group, while Lord McGowan at the Central Council meetings (which are attended by all the Executive Directors of the company) gives a general review of the position of the company at home and abroad, in retrospect and prospect.

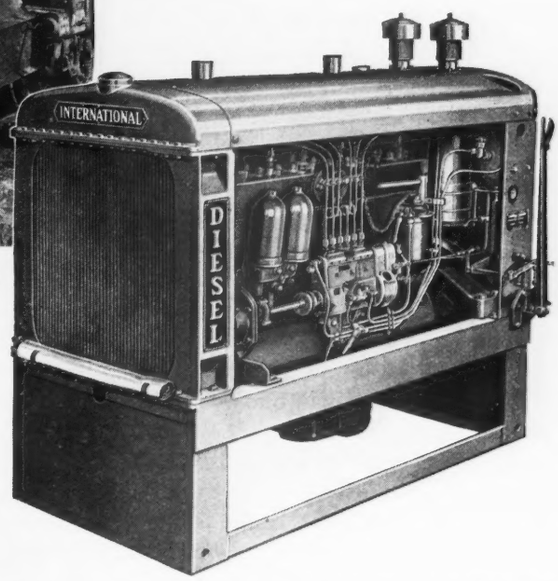
In fact, it is the considered policy of the company to break down that traditional "hush hush" in company affairs and to take the workers into the completest practicable confidence.

A feature of the plan is that any matter that may concern the workers at the smallest plant can be ventilated at the Central Council in the hearing of the Directors if it has not

How a Foundry Saves $82 a Month in the Handling of Sand and Coke



This 20-ton locomotive crane powered by an International PD-80 Diesel Power Unit is used with a large clamshell bucket handling molding sand and coke for a large foundry in New York State. A gasoline engine, formerly used, consumed 600 gallons of 16-cent fuel a month. The International PD-80 uses only 227 gallons of 6-cent fuel a month—a saving of $82.38. And according to the operator "It runs steadier and does harder work". Two International Industrial Tractors and two International Trucks are also used by this firm and are giving complete satisfaction.



Model I-12 Industrial Tractor

Compact, economical power is available in the small International I-12 Industrial Tractor shown above. It uses only about a gallon of gasoline an hour on the job. This tractor is only 99 inches long, slightly over 4 feet wide, and turns within a circle having a radius of 8½ feet. This enables it to work in cramped and close quarters. You will find a great many uses for this husky tractor. Other International Industrial Tractors available in wheel and crawler types.

Power costs are cut to the bone on many operations by the International PD-80 Diesel Power Unit. This big 6-cylinder engine develops a maximum of 100 h.p., and 80 h.p. under continuous load. Where peak loads require more power, multiple installations prove a worthwhile investment. This unit combines the advantages of INTERNATIONAL Diesel engine design with the economy of Diesel fuel to give you low maintenance costs as well as low operating costs. It is the only 6-cylinder Diesel engine that can be cranked by hand. Investigate the Model PD-80 for your own power requirements. Other engines in the International line range up to 110 max. h.p. for gasoline, natural gas, or distillate operation. There also is a 4-cylinder Diesel engine. The nearby International industrial power dealer or Company-owned branch will give you complete information.

INTERNATIONAL HARVESTER COMPANY
(Incorporated)
180 No. Michigan Ave. Chicago, Illinois

INTERNATIONAL Industrial Power

Have you a substitute for EXPERIENCE?

We haven't, and we don't believe there is any. Our experience in building multiple V-Belt drives covers the whole range from 1/4 hp. to 2000 hp. The engineering refinement necessary to build a 1/4 hp. drive, and the engineering ability and manufacturing facilities necessary to build a 2000 hp. drive, combine into a diversified breadth of experience which is built into every Texrope Drive.

Allis-Chalmers originated, developed and pioneered the multiple V-Belt drive principle, and has conceived and developed all its improvements and variations such as the Duro-Brace and Vari-Pitch Sheaves and the Straitline Automatic Ball Bearing Motor Base. When you buy Texrope Drives you are buying drives that have resulted from vast experience and are produced by the most complete and up-to-date manufacturing facilities.

Before buying a multiple V-Belt drive consult multiple V-Belt headquarters—Texrope Division, Allis-Chalmers Manufacturing Company.

Write for Vari-Pitch Bulletin No. 1261-A and Duro-Brace Bulletin No. 2188-B

Belts by Goodrich

TEXROPE DIVISION

ALLIS·CHALMERS

MILWAUKEE WISCONSIN

100 Standard Models of Industrial Counters

Durant *Productimeters* for 58 years have recorded the output in all fields of industry. Counters and registering instruments for almost any industrial use can be supplied from stock. We are also constantly designing counters to meet new or special problems. Let a Durant engineer consult with you on the best means of equipping your plant with counting machines.

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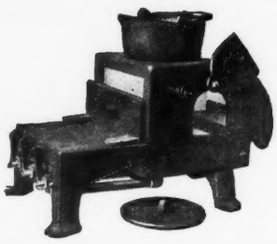
TELL US WHAT YOU WANT TO COUNT

JOHNSON No. 118

COMBINATION BENCH FURNACE



Here's the ideal Bench Furnace for any shop use. Designed for heating the largest soldering coppers, branding irons and stenciling irons; also for tempering, annealing, case-hardening or soft metal melting. Heating long rods or sweating joints is done through the side doors of the curved shaped hood. Equipped with removable 22-lb. capacity melting pot. Fired by three powerful Johnson Bunsen Burners. For full details, write for free catalog.

JOHNSON GAS APPLIANCE CO.
Cedar Rapids IOWA

been satisfactorily disposed of at either the works or group council.

These councils, used as we use them, are a most powerful influence in promoting understanding between management and men. They not only educate the workers in management problems, but educate management in the company's labor policy and act as an effective check on any manager who may be inclined not to treat his individual workers with sympathy and understanding.

The adoption of a labor policy such as ours undoubtedly imposes greater obligations on the management of a plant. They are required under it to devote more time and trouble to the cultivation of the good will of their workers; they are required to educate their foremen in the company's policy; they must sacrifice autocratic methods and go to considerable pains to secure the willing intelligent cooperation of the men. All this takes the time of management, but we believe that it is very well worth while.

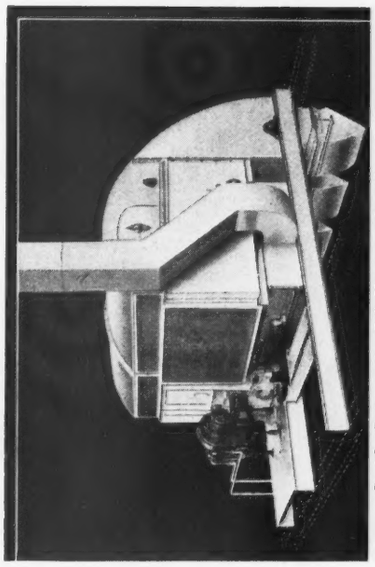
"Humanism" in Plant Life

We think there is too great a tendency on the part of management to take for granted the human factor in production and to assume that a man gave of his best under the old methods of management, whereas all the time there is a tremendous reserve of productive power in the individual which is only called forth in the degree that management imports "humanism" into the day-to-day life of the plant.

We bear continually in mind that, as the unionization of our plants extends and external influences are brought more and more to bear on our men, so it is more than ever necessary to maintain and develop a progressive internal policy of industrial relations.

We believe in identifying ourselves with the inevitable. We recognize the influence of the trade unions. We recognize the changed outlook of the British workman with his greatly improved standard of life and his demand for the opportunity to improve that standard still further. We recognize the checks and limitations now placed on managerial authority. We recognize the need for much more consideration of the individual worker's personal preference and temperament. And with all that, we recognize fully that the results to our enterprise are amply worth all the time and effort involved.

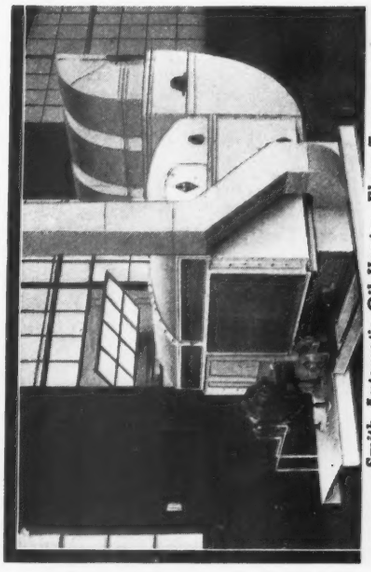
My single suggestion, therefore, to you in America is that you adopt our policy of identifying yourselves

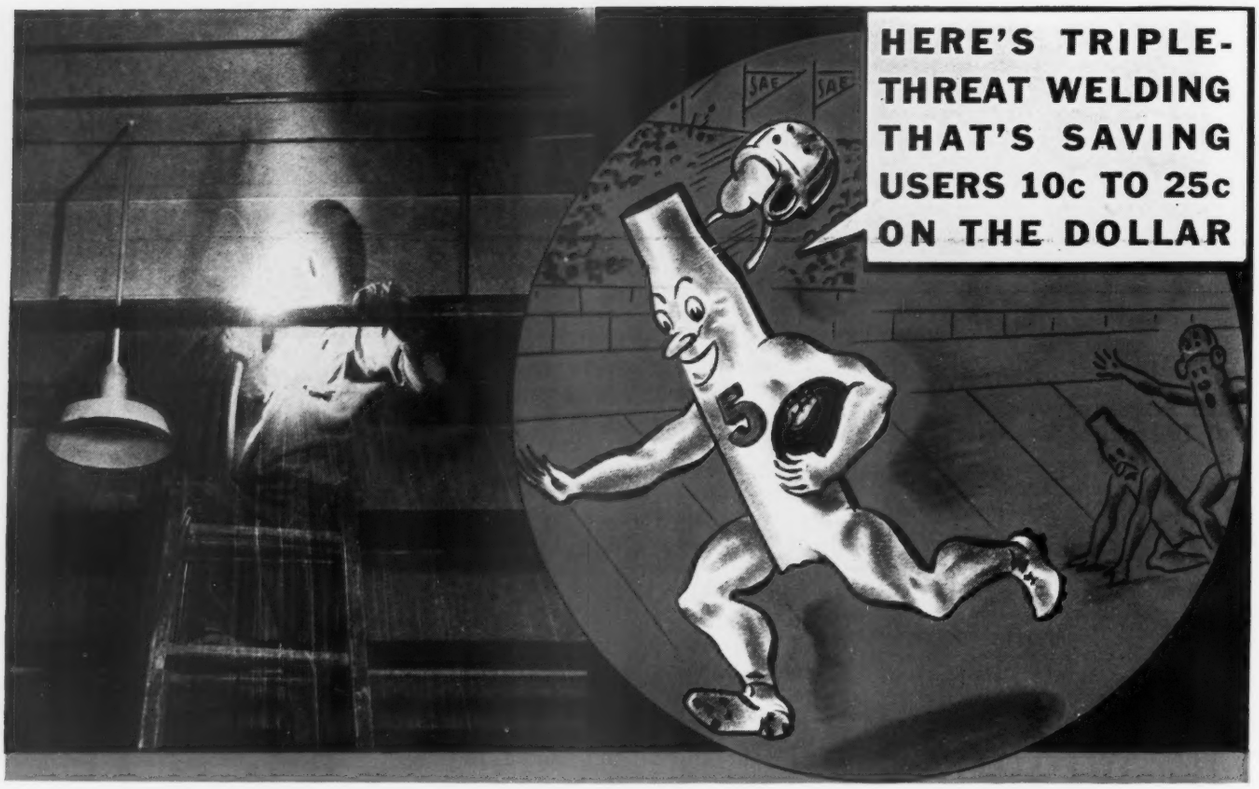

Smith Automatic Oil Heater, Overhead Type

Smith Automatic Gas Heater Halves Cost of Steam Plant

Burns Bunker "C" (No. 6) oil, light oil, gas or coal. Automatic—no "minding" from fall to spring. No steam lines or boiler room. On floor or in trusses. 85% efficiency. Only 7 feet head room for largest size. Low fuel cost, upkeep almost nothing, installation cost half that of a steam plant. Product of 15 years' heating experience . . . . Describe your needs.

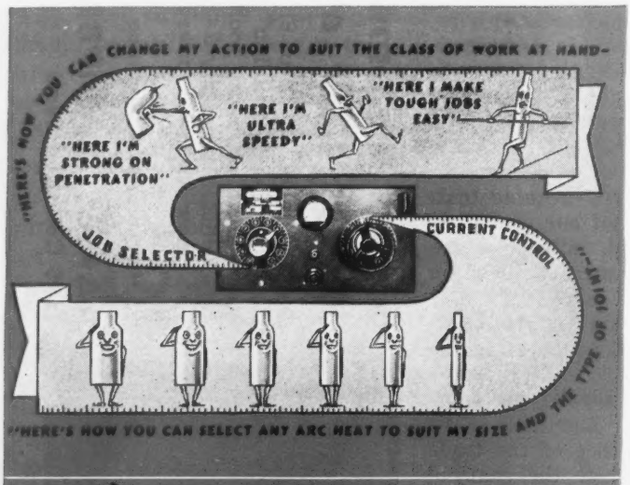
JAMES CAMPBELL SMITH, INC.
1675 Collamer Road Cleveland, Ohio


Smith Automatic Oil Heater, Floor Type



In this plant "Shield-Arc SAE" saved more than 25% over other pipe installation methods. A total of 4860 ft. of water and steam piping, 1½" to 6" in diameter were installed.

"Use Me With The New 'Shield-Arc SAE' And You'll Lower Welding Costs These 3 Ways"...


"HERE'S HOW YOU CAN CHANGE MY ACTION TO SUIT THE CLASS OF WORK AT HAND—
"HERE I'M STRONG ON PENETRATION"
"HERE I'M ULTRA SPEEDY"
"HERE I MAKE TOUGH JOBS EASY"
JOB SELECTOR
CURRENT CONTROL
"HERE'S HOW YOU CAN SELECT ANY ARC HEAT TO SUIT MY SIZE AND THE TYPE OF JOINT—"

"ONE—You get better welds 15% to 20% faster because its Job Selector gives you the right TYPE of welding arc to suit the job.

"TWO—You cover a wider range of application because of its Dual Continuous Control. In effect, you get two or three welders of different ratings when you buy an 'SAE.'

"THREE—You can use me in my larger sizes—weld faster and continuously because the 'SAE' is self-protected against burnout.

"If you want yardage gains in welding, just play ball with Lincoln. Yours for lower welding costs,

"FLEETWELD ROD"
—Spokesman for all progress-minded welding electrodes and emissary of

THE LINCOLN ELECTRIC COMPANY
Largest Manufacturers of Arc Welding Equipment in the World

THE LINCOLN ELECTRIC CO., Dept. R-437, Cleveland, Ohio

My welding application is_____
How can the "SAE" do it faster?

☐ Send a free copy of Bul. 412 giving details about the new *"Shield-Arc* SAE" welder.

Name _____ Position _____

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LINCOLN "SHIELD-ARC SAE"
THE WELDER WITH DUAL *CONTINUOUS* CONTROL

with the inevitable. Whatever the modern trend is, get next to it. Don't try to fight it, but try to influence it. The methods you adopt may differ radically from ours, but the underlying philosophy should be the same.

You are passing through a difficult time; as a nation you have perhaps attempted to compress into three or four years, stages of national development that have taken us in Britain 60 or 70 years. The pendulum has swung for you from complete individualistic freedom almost to the other extreme. You have now to demonstrate to the forces of extremism, whether they be of the right or of the left, that American industry can render its service to the community on terms that are unchallengeably fair to that community, while at the same time meeting the continually developing human needs of these engaged in that industry.

"Where there is no vision, the people perish." The old verse as applied to peoples is very true of modern industry: "Where there is no vision, that industry will perish."

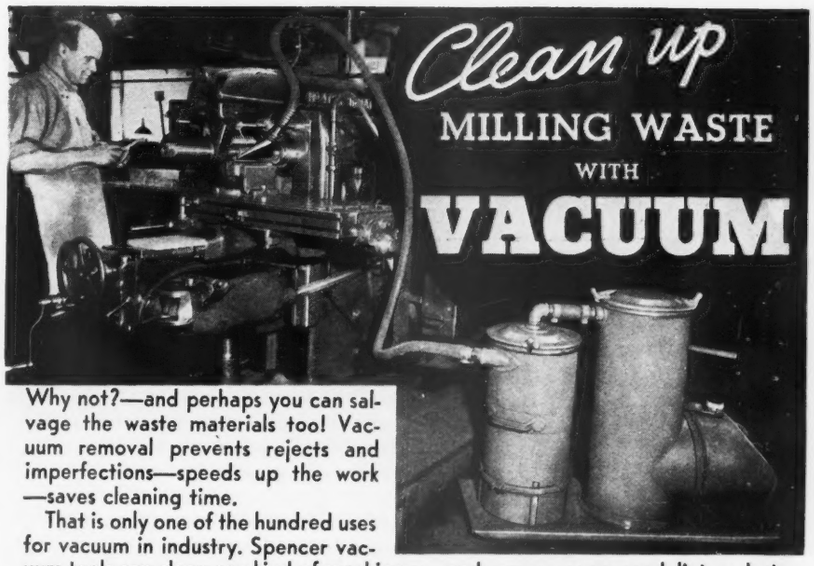
What Instruments Have Done for the Other Fellow

(Continued from page 87)

process for each charge. Thus it helps to keep processes uniform and maintain a constant, individual check on the operators of the beaters.

In a metal working shop a recording instrument installed in the circuit of a motor driving a punchpress reduced loss of punchings resulting from worn dies. Many punchings were spoiled by raised burrs. By using a recording meter it was found to be possible to determine when a die should be removed and reground.

It is commonly considered that recording instruments are not so sensitive as indicating instruments: that it is impossible to obtain high-sensitivity records. No longer is this true. It is now possible to record accurately, with the photoelectric recorder, power consumption of as little as a billionth of a watt. In general, the photoelectric recorder makes it possible to record continuously any measurement that can be indicated. It also makes possible the recording of readings that could not be obtained by any other known method. The recording element is distinct from the sensitive basic instrument in the measured circuit, a beam of light connecting the two. Thus the measured circuit is not



Why not?—and perhaps you can salvage the waste materials too! Vacuum removal prevents rejects and imperfections—speeds up the work—saves cleaning time.

That is only one of the hundred uses for vacuum in industry. Spencer vacuum tools can clean any kind of machinery—and remove soap, sand, lint or dust.

Used at first to reduce dust hazards, they are now a recognized production tool—just like compressed air or steam. In fact, many companies have installed Spencer *Vacuum Lines* all over their plants.

Clean the machines, the walls, the floors, the shipping room with a trial installation of a Spencer Portable Vacuum Cleaner and see what a difference it makes.

Our nearest representative will call, if you say the word.

SPENCER HARTFORD
CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS
123-A
THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

NOT UNCOMMON ARE EFFICIENCIES UP TO 98%

Good Engineering makes possible the power economies in every WOOD'S V-BELT DRIVE . . . is *visible* in smooth perfection of operation.

Watch a WOOD'S drive like this on a Hammer Mill . . . see the instant, even pick-up, the snug seating of V-Belts into sheaves, the smooth run notably free from backlash, jerk, slippage or vibration. Remember that a drive of this type is subject to severe shock, overload and sharp variations in speed.

You're seeing a V-Belt Drive at its best—under the worst conditions.

You're seeing the way a WOOD'S drive will behave in your plant in even the most gruelling service.

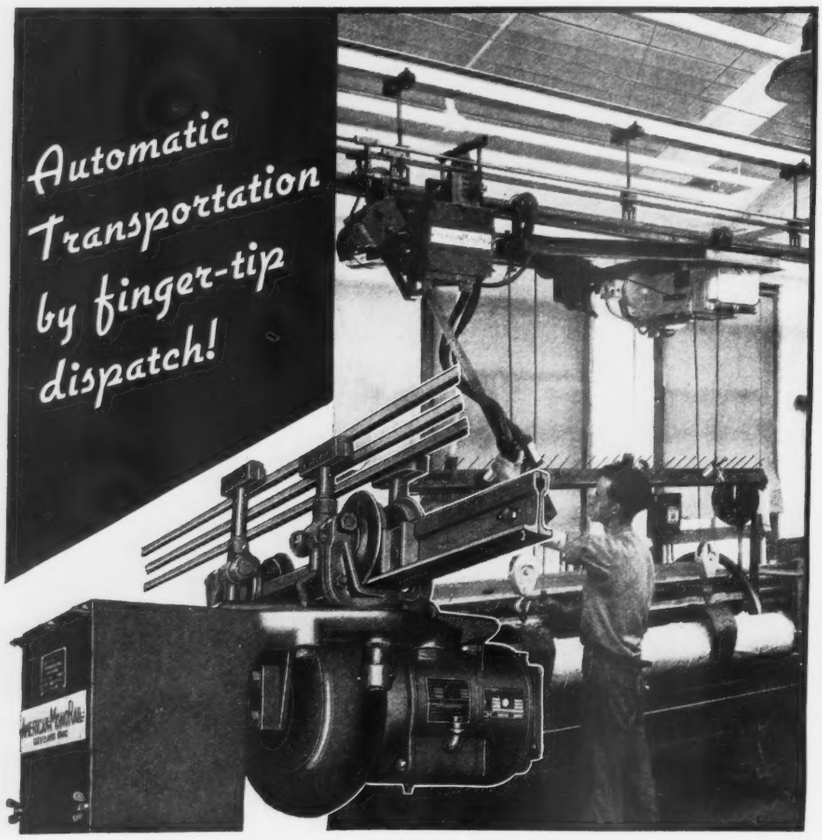
You can gauge exactly what it will do by what it is doing for plants throughout the world.

Details? They're yours, promptly, upon request.

T. B. WOOD'S SONS COMPANY • **Chambersburg, Pennsylvania**

50 Church St., New York, 387 Atlantic Ave., Boston

Member: Mechanical Power Engineering Associates



Loads as heavy as three tons are now dispatched for automatic transportation over monorail systems by means of the American MonoTractor.

This rubber wheel drive unit successfully propels hoists, carriers, and cranes at speeds up to 300 feet per minute.

It operates through track switches, up 10% grades, over scale or lift sections with local or remote control or completely automatic from central control panel. Some loading and unloading operations are also performed automatically.

For a complete labor saving system, the American MonoTractor is indispensable. Engineering service furnished without cost. Complete information will be sent on request.

AMERICAN MONORAIL CO.

13114 Athens Ave., Cleveland, O.

called upon to supply the relatively large amount of energy required by the recorder.

With such recorders broadcasting station signal strength can be recorded; pulse rates can be graphed; light-time curves are given; performance tests of refrigerators are recorded; superficial and internal body temperatures are graphed. A recent application recorded temperature changes of as little as 0.003 deg. C in a standard-cell oil bath.

When Wiring Your Plant

(Continued from page 93)

difficult to establish a definite value of current beyond which bus should be used, because many factors must be considered. Probably it is safe to say, however, that when installation conditions are favorable it will be advisable to consider the use of bus when the current to be transmitted is more than 1,000 to 2,000 amperes.

The first requirement is that a bus be located in a protected place, such as under a good, dry floor, or inclosed in a metal or concrete structure. In any event it must be protected from dirt and moisture, but at the same time must be ventilated. Bus-insulating materials such as porcelain, micarta, ebony asbestos, and the like can be used to give a high factor of safety, which can readily be increased if desired at only a small increase in cost.

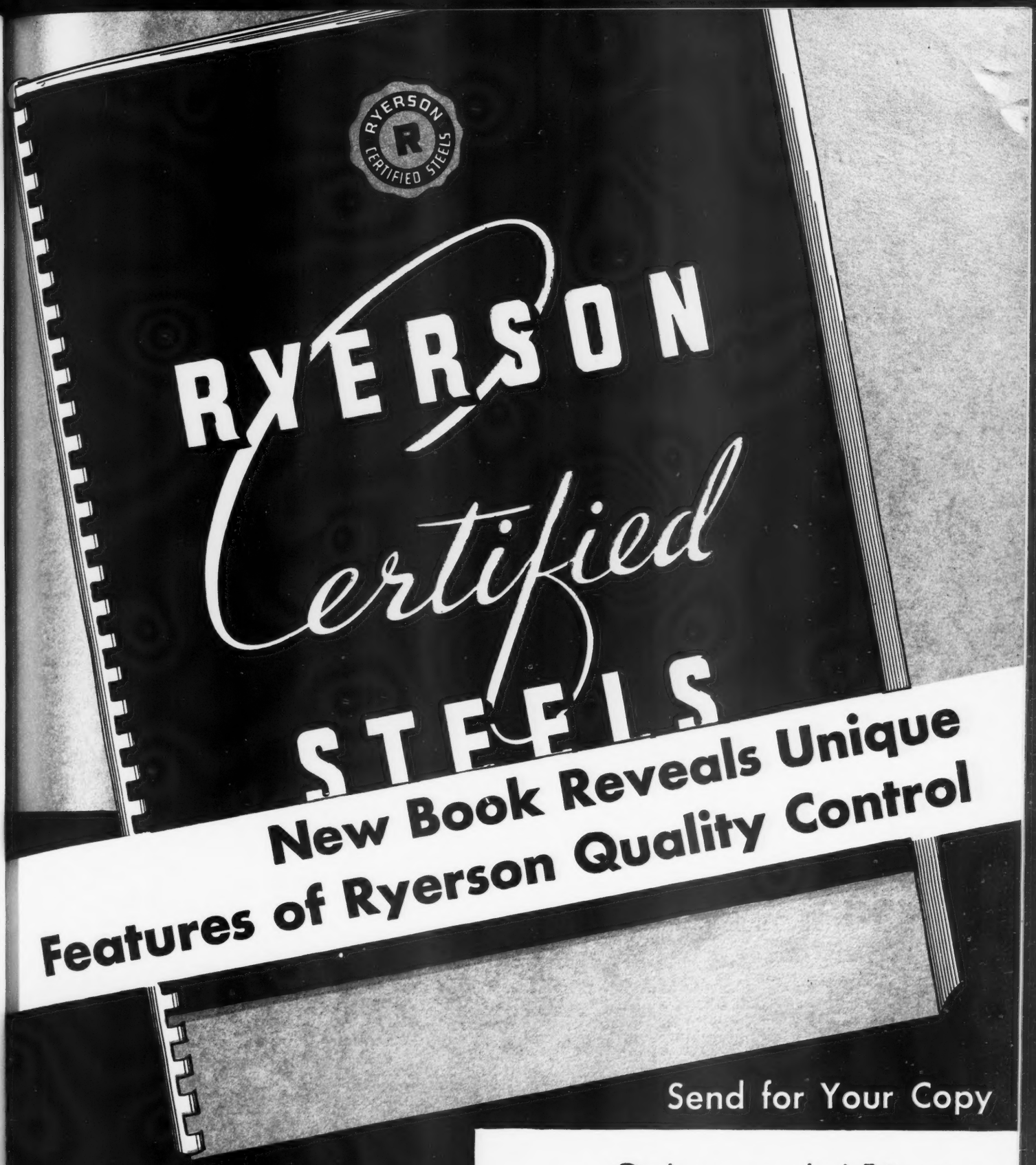
All the supporting structure must be of sufficient strength to withstand the mechanical stresses brought about during short circuits.

It is quite important to remember that ventilation should not be permitted to assist a local fire in spreading over the full length of the bus. In some cases a wire mesh covering will be sufficient to prevent such an occurrence; in others full steel or concrete inclosures may be required.

There is considerable choice of bus shapes, such as flat bar, standard pipe size and extra-heavy copper tubing, channels, and angles. In general, below 1,000 amp. flat bar may prove to be the most economical. Above 1,000 amp., channel or angle may be the most economical. Angles have somewhat better heat-dissipation characteristics than channels; hence, with proper ventilation angle bus will tend to run a little cooler, or a slightly smaller cross-section can be used.

Channels and angles always have better mechanical strength than

(Continued on page 160)



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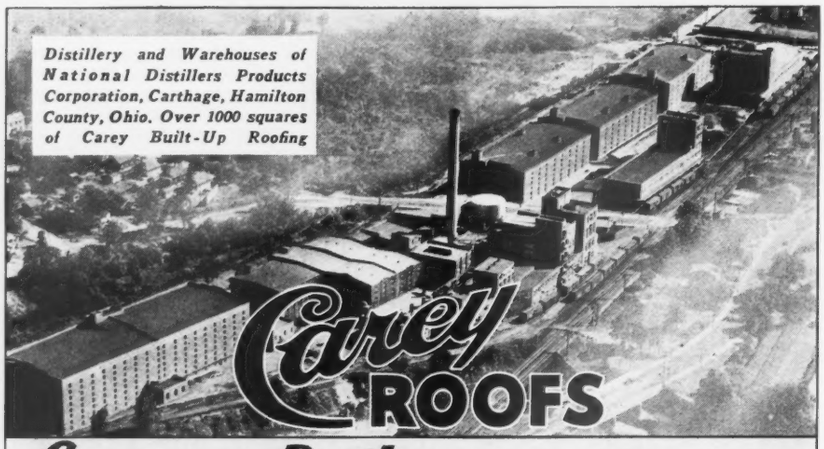

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(*Continued from page* 156)

bars against short-circuit stresses. Tubing is used more frequently for special cases, such as central station or substation buses.

Choice of shapes for a bus will be strongly influenced by mechanical considerations, as well as the amount of current to be carried. These factors are important:

1. Length of run;
2. Number of taps;
3. Distance between supports;
4. Short-circuit stresses;
5. Space available.

They must all be properly weighed before a decision is reached as to what should be used. It is quite possible to run the cost of fittings up as much as four times the minimum necessary, if the designer lacks familiarity with fittings and fitting costs. In addition, installation costs vary somewhat with the shape of bus selected.

(A succeeding article will appear in an early issue.—ED.)

•

TRADE LITERATURE

(*Continued from page* 116)

Conveyor—Bulletin 36-1, describing quench tank conveyor.—Anchor Steel & Conveyor Co., 2503 Bellvue St., Detroit.

Cooling Towers—Three bulletins: No. 190 on Type K induced-draft spray cooling towers, No. 170 on Type FD forced-draft cooling towers, No. 160 on Type R atmospheric spray cooling towers.—Binks Mfg. Co., 3114-40 Carroll Ave., Chicago.

Electrical Equipment—Folder, showing line of electric pliers, fuse clip clamps, wire strippers, grinders, etc.—Ideal Commutator Dresser Co., 1005 Park Ave., Sycamore, Ill.

Electrophoto Controls—Leaflet, on electrophoto controls.—United Cinephone Corp., Long Island City, N. Y.

Feedwater Treatment—Bulletin No. 1542, on Akon feedwater treatment.—Allis-Chalmers Mfg. Co., Milwaukee.

Flexible Couplings—Catalog, containing data sheets on line of flexible couplings.—Ajax Flexible Coupling Co., Westfield, N. Y.

Floor Plates—Booklet, on non-skid, rolled-steel floor plates.—Central Iron & Steel Co., Harrisburg, Pa.

Governors — Bulletin GEA-1162A, on CR2922-E pressure governors for use with automatic starters on pumps or compressors.—General Electric Co., Schenectady, N. Y.

Hacksaw Blades—Catalog 51, on line of Star hacksaw blades.—Clemson Bros., Inc., Middletown, N. Y.

Hard Facing—Booklet F-3491, title "Steel Hard Facing Procedure."—The Linde Air Products Co., 205 East 42d St., New York.

Heating—Bulletin, on "Airblanket" heating method for preventing accumulation of high temperatures under roofs.—Airtherm Mfg. Co., 1474 South Vandeventer, St. Louis.

Instruments—Bulletin GEA-2645, on small panel instruments.—General Electric Co., Schenectady, N. Y.

Instruments—Folder, describing balanced vapor pressure system used on dial and

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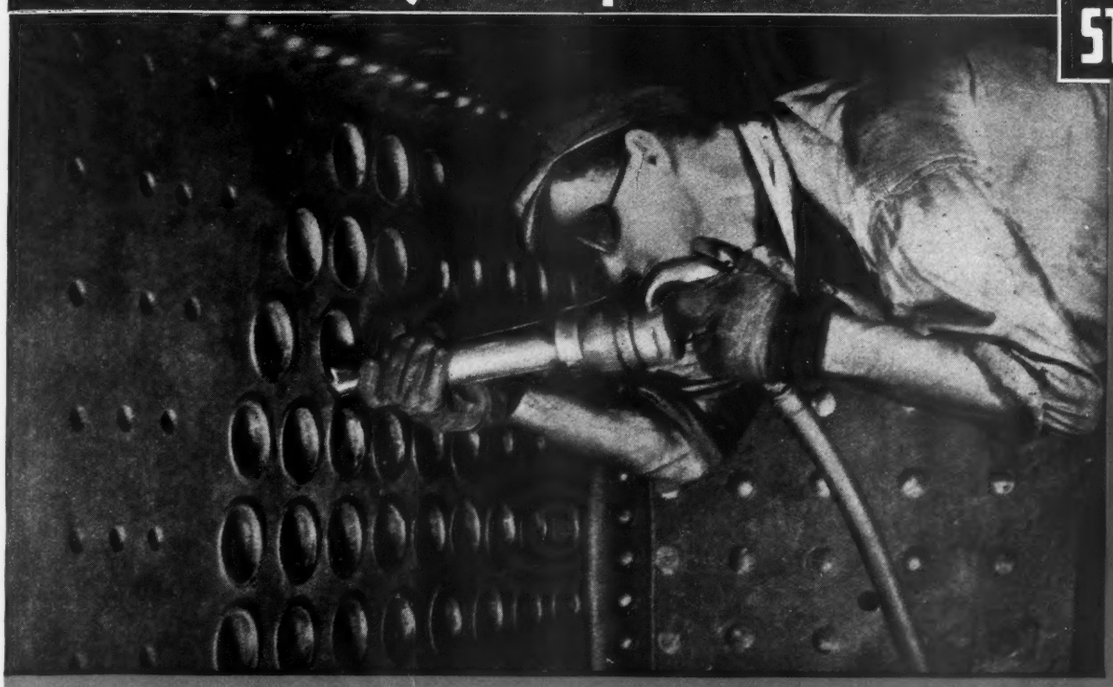

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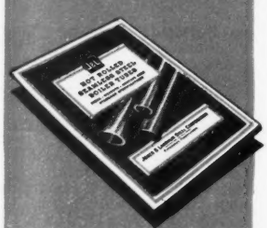

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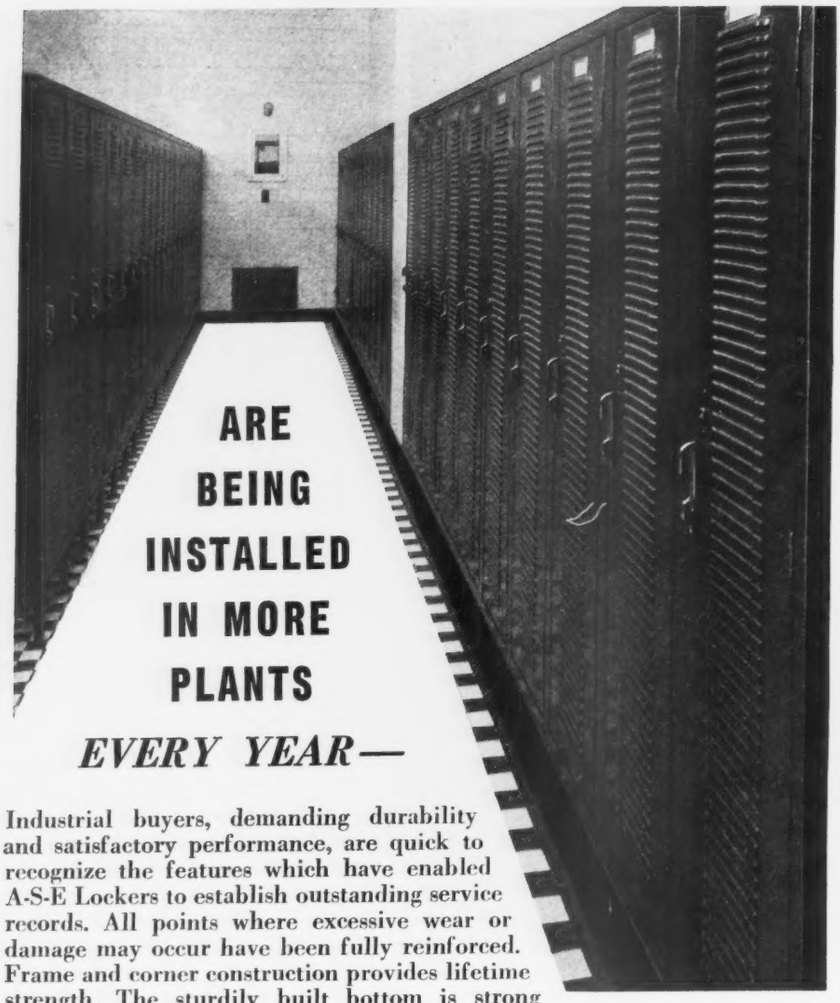

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recording thermometers.—American Schaeffer & Budenberg Instrument Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Insulating Varnishes—Catalog, on line of insulating varnishes and compounds.—John C. Dolph Co., 68 Emmett St., Newark, N. J.

Lacquers—Two bulletins: one on "Blue Knight Roxyn C" chemical-resistant finish; one on "Cadmium Water Dip Lacquer No. 3850."—Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J.

Lathe—Bulletin 1246-18-1, on 18-speed, geared-head precision toolroom lathe.—The Hendey Machine Co., Torrington, Conn.

Lighting—Bulletin ML6, showing equipment for localized lighting to meet all types of needs.—The Fostoria Pressed Steel Corp., Fostoria, Ohio.

Lighting—Catalog No. 38, showing full line of lighting equipment.—Goodrich Electric Co., 2900 North Oakley Ave., Chicago.

Liquid Heating—Bulletin No. 42, on apparatus for heating corrosive liquids.—Heil & Co., 3088 West 106th St., Cleveland.

Lubricating Devices—Catalog No. 58, on line of oilers, oil seals, and lubricating devices.—Gits Bros. Mfg. Co., 1846-62 South Kilbourn Ave., Chicago.

Materials Handling Equipment—Catalog, showing line of trucks, trailers, carts, wheelbarrows, etc.—Lansing Co., Lansing, Mich.

Mixer—Booklet, on aluminum Typhoon mixer.—The Patterson Foundry & Machine Co., East Liverpool, Ohio.

Motors—Bulletin GEA-1844A, on Type KSP shaded-pole motors.—General Electric Co., Schenectady, N. Y.

Nozzles—Bulletin No. 150, on nozzles for water cooling, air washing, and air conditioning.—Binks Mfg. Co., 3114-40 Carroll Ave., Chicago.

Oil Pumps—Publication L-32-10, on IMO oil pumps.—De Laval Steam Turbine Co., Trenton, N. J.

Paging System—Folder, describing automatic paging system.—The Babaco Co., 447 West 19th St., New York.

pH Papers—Folder, describing test papers for determining pH of plating solutions.—The Udylite Co., 1651 East Grand Blvd., Detroit.

Production Control Instruments—Bulletin No. 3707, describing three models of Chronologs, production control instruments.—The National Acme Co., 146 East 131st St., Cleveland.

Pumps and Motors—Bulletin 47,000, on fluid power pumps and motors.—The Oilgear Co., 319 West Bruce St., Milwaukee.

Pyrometer—Bulletin No. 503, on sensitive high-resistance indicating pyrometer.—Wheelco Instruments Co., 1929 South Halsted St., Chicago.

Pyrometers—Catalog No. 1102, on potentiometer-type pyrometers.—The Brown Instrument Co., Wayne & Roberts Ave., Philadelphia.

Rolling Doors—Bulletin, showing motor-operated rolling doors.—The Kinnear Mfg. Co., 7000 Fields Ave., Columbus, Ohio.

Rubber Flooring—Picture portfolio, showing installations of rubber flooring.—The Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

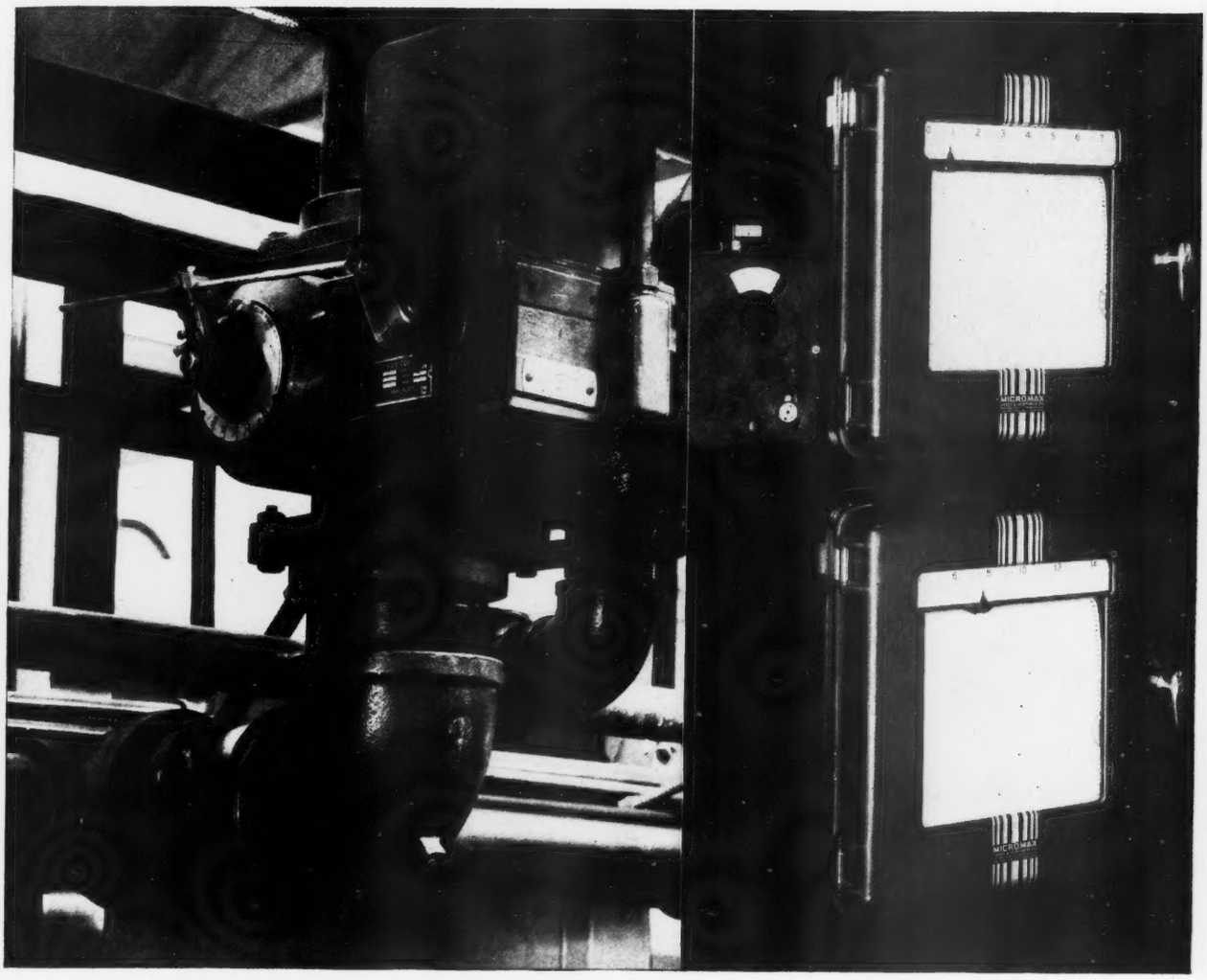
Shims—Specification File containing detailed specifications of Laminum laminated brass shim stock.—Laminated Shim Co., Long Island City, N. Y.

Spray Equipment—Catalog, on complete line of spray painting and finishing equipment.—Binks Mfg. Co., 3114 Carroll Ave., Chicago.

Stainless Steel—Book, title "The Working of Silcrome Stainless Steel."—Ludlum Steel Co., Watervliet, N. Y.

Steam Turbine Units—Bulletin No. 1180, on condensing reaction-type steam turbine units.—Allis-Chalmers Mfg. Co., Milwaukee.

Switches—Bulletin 371-MT, on Ferro-Tube mercury contacts.—Jefferson Electric Co., Bellwood, Ill.



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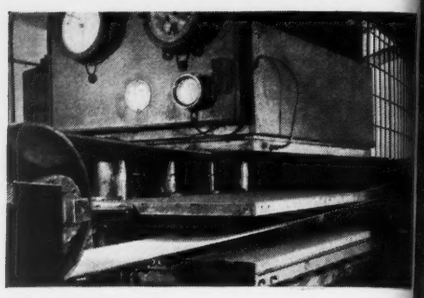

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Switches—Catalog 603, describing Kon-nector mercury switches.—General Electric Vapor Lamp Co., Hoboken, N. J.

Test Indicator—Leaflet, on two models of test indicators.—Federal Products Corp., 1144 Eddy St., Providence, R. I.

Transformers—Bulletin GEA-2434, on Types JE-41 and JE-42 indoor potential transformers.—General Electric Co., Schenectady, N. Y.

Turbines—Leaflet E-1169, title "Modern Turbines to Reduce Costs."—De Laval Steam Turbine Co., Trenton, N. J.

Unit Heater—Folder, describing "Projection" unit heater for ceiling mounting.—The Trane Co., La Crosse, Wis.

Unit Heaters—Bulletin 75, on Torridor blower-type unit heaters.—The Trane Co., La Crosse, Wis.

Valves—Bulletin 7500-C, on Flocontrol Valves.—Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Voltage Regulators—Bulletin GEA-2544, on feeder voltage regulators.—General Electric Co., Schenectady, N. Y.

Water Heaters—Bulletin No. 35-76, on water heaters.—American District Steam Co., North Tonawanda, N. Y.

Welding—Folder, title "The Characteristics of a Modern Arc Welder."—Harnischfeger Corp., 4400 West National Ave., Milwaukee.

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BOOKS

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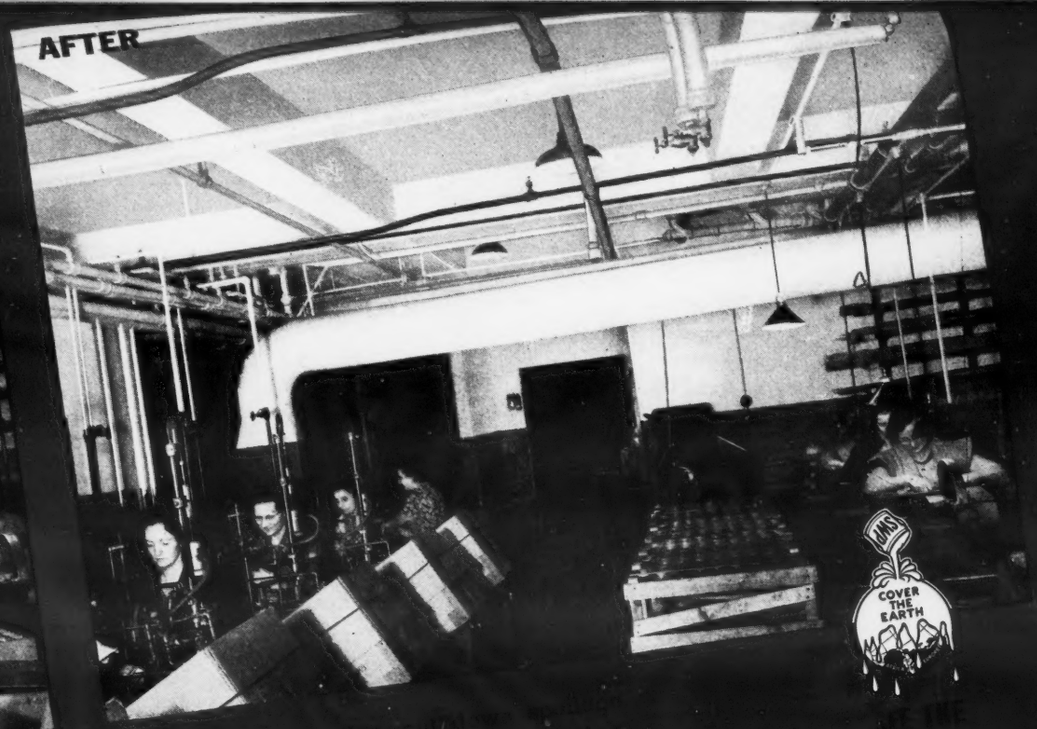

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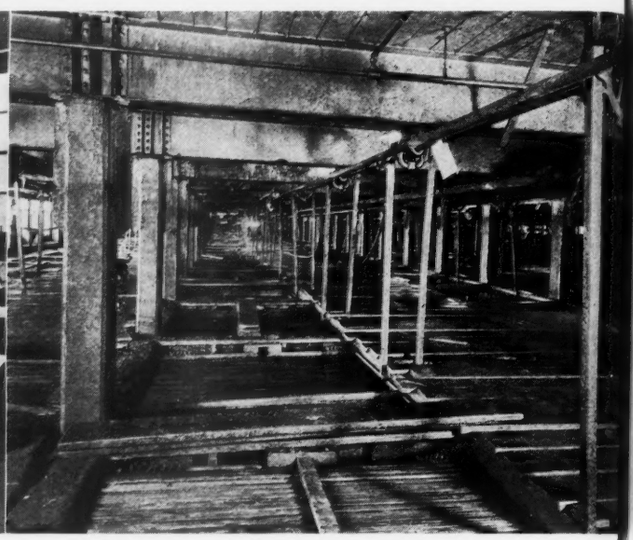
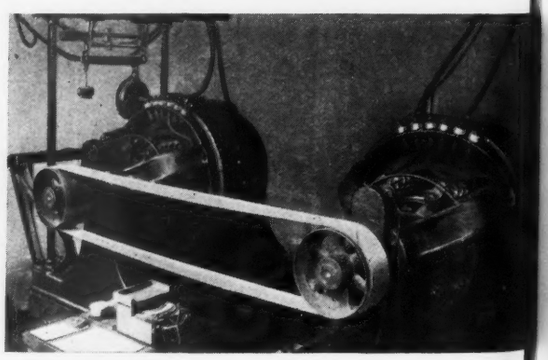
NOBODY HAS ASKED US TO PAY BACK THE MONEY . . .

Here . . . the ingredients are prepared which give Research Belting its greater coefficient of friction.



Here . . . the leather becomes more resistant to stretch — longer-lived.

GUARANTEE
Research Leather Belting will increase average machine production at least 1 or 2% over ordinary belting or the full purchase price will be refunded in exchange for the belting.
Graton & Knight Company



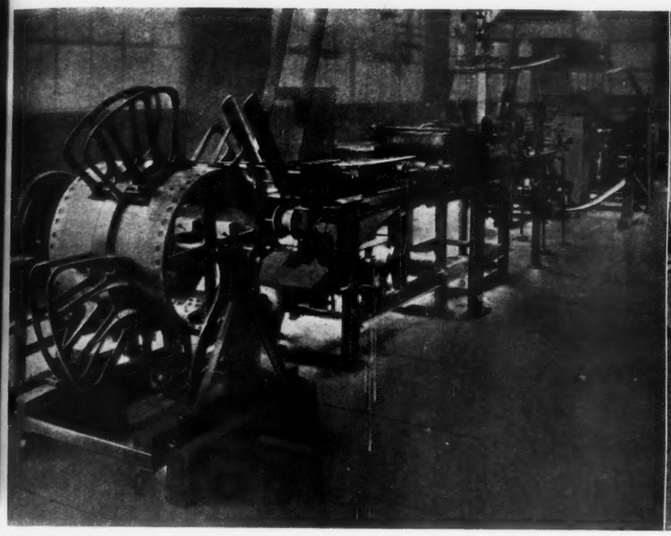
Here . . . on the 50 H.P. Dynamometer, their ability to transmit power without slippage, is tested.

This . . . is your guarantee of increased production. Have Research Belting placed on an important drive where increased production can be easily measured. You'll find the name of the nearest jobber or branch office in the Graton & Knight insert in THOMAS' REGISTER.

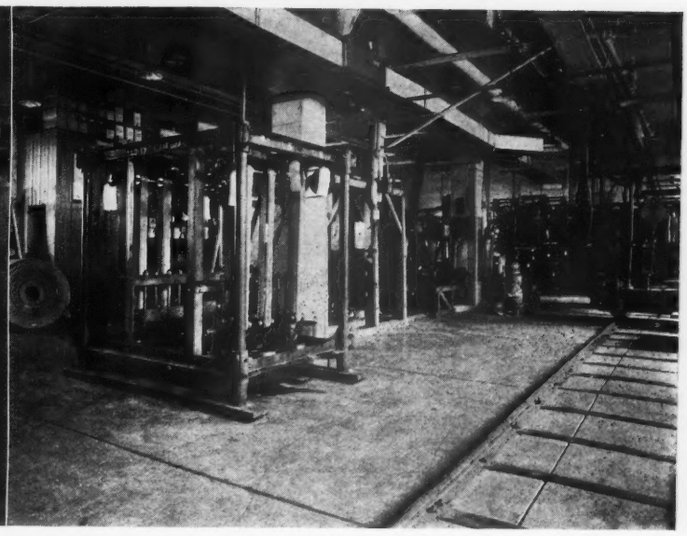
RESEARCH

from the Home of Research

Research Belting's "you-profit-or-we-pay" offer has been in force since last December. Never has a customer asked us for his money back. Research must be increasing production!



Here . . . tension-cementing — a *patented* feature — makes waterproof laps and plies inseparable.



Here . . . samples are taken from production to be tested in a Chamber of Tortures.

And here . . . on your drive, Research Belting will increase average machine production at least 1 or 2% over ordinary belting.

Bonuses Like These — Can Be Made In Your Plant

Grinder: 8% more production an hour
Blower: Speed increased from 2700 to 2800 r.p.m.
Card: 4% more production
Compressor: So much more air from one, another could be shut down
Head rig: Research does twice as much work
Linter: Over 3 tons more per day
Spinning frames: 15 feet more yarn per hour
Drill: 25% saving in cost of operation
Vertical drive: 9% more r.p.m.
Compressor: 17⅔ cents extra profit on each tank of chemical
Generator: 15% more power
Looms: $2.88 a year bonus per loom

MODERN GROUP DRIVE

Graton and Knight

BELTING

Worcester, Mass . . .

HE NEEDED A 1½ TON CAPACITY CASTER

and found it as near as his telephone!

He thought his caster problem "was different" — he called a leading mill supply house for advice — and found exactly what he needed in the Dreadnaught! This happy solution of unusual caster requirements occurs hundreds of times each day. For somewhere in the extensive Faultless line are casters that exactly and economically satisfy every industrial requirement. No matter what your caster problem may be, you'll find a way to cut transportation costs in your copy of the OD Catalog, available for the asking.

No. 1500 Series Heavy Duty, Triple Ball Bearing Swivel, With Semi-Steel Hyatt Bearing Wheel.

FAULTLESS CASTER CORP.

Dept. FM-11.

Evansville, Indiana

Representatives in Principal Cities
Canadian Factory: Stratford, Ontario

FAULTLESS CASTERS FOR INDUSTRY

1937–38 MECHANICAL CATALOG

The American Society of Mechanical Engineers, 29 West 39th St., New York. 396 pages.

Twenty-seventh annual volume. First part contains catalogs of industrial equipment, materials, and supplies. The second part is a classified index to manufacturers. An alphabetical list of manufacturers comprises part three.

PREPARATION FOR SEEKING EMPLOYMENT

Howard Lee Davis, Director of Technical Employment and Training, New York Telephone Company. John Wiley & Sons, Inc., 440 Fourth Ave., New York. 39 pages. $.25.

Mr. Davis, author of *The Young Man in Business,* says in his foreword "Of all salesmen everywhere, those who offer to sell their own personal service are the only ones who try to conduct a sales campaign without specific knowledge of their product and its market." He goes on to show men how to determine what they have to offer an employer and how to present their story to him.

PAPERS ON THE SCIENCE OF ADMINISTRATION

Edited by Luther Gulick and L. Urwick. Institute of Public Administration, 305 East 35th St., New York. 196 pages. $3.

Papers brought together in this collection are essays by outstanding authorities in the theory and practice of public and private organization and administration in the United States and abroad. The theory and principles of organization, function of administration, process of control, and relationship in organization are some of the subjects covered.

GETTING THINGS DONE IN BUSINESS

Everett B. Wilson, Formerly Assistant Director of Personnel, Kroger Grocery and Baking Company. McGraw-Hill Book Co., Inc., 30 West 42d St., New York. 267 pages, index. $2.50.

Mental "sit-downs" have been going on for years, says the author, and this book aims to show executives how to end them. It shows the significance of leadership, how to develop it, and how to put it to use; gives instructions for getting subordinates to do things the way management wants them done.

•

ON THE CALENDAR

NOVEMBER

10–12, International Acetylene Association, Annual Convention, Birmingham, Ala. H. F. Reinhard, Secretary, 30 East 42d St., New York.

DECEMBER

5–9, National Association of Manufacturers, Annual Congress of American Industry and Annual Convention, New York. Noel Sargent, Secretary, 11 West 42d St., New York.

6–10, Annual Meeting, American Society of Mechanical Engineers, New York. C. E. Davies, Executive Secretary, 29 West 39th St., New York.

6–11, Sixteenth Exposition of Chemical Industries, New York. Charles F. Roth, International Exposition Co., Grand Central Palace, New York.

9–10, Annual Conference, The Society for the Advancement of Management, New York. Evelyn Buckley, Assistant Secretary, 29 West 39th St., New York.

JANUARY

13–15, American Engineering Council, Annual Meeting, Washington, D. C. F. M. Feiker, Secretary, 744 Jackson Place, Washington, D. C.

24–28, American Society of Heating and Ventilating Engineers, Annual Meeting, New York. A. V. Hutchinson, Secretary, 51 Madison Ave., New York.

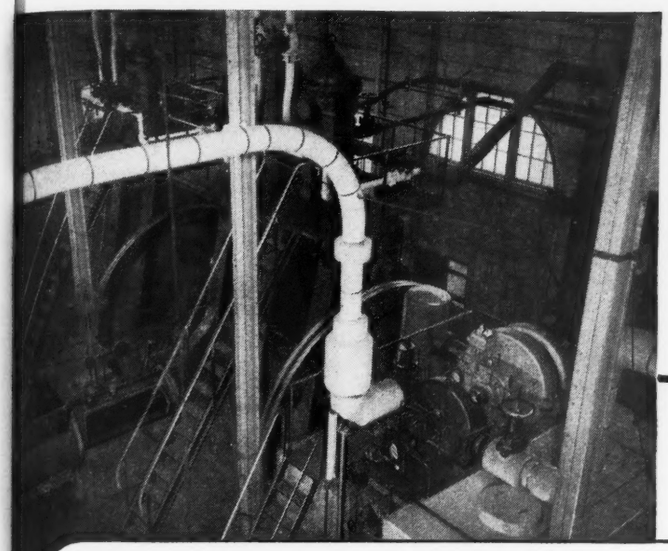
24–28, Fifth International Heating and Ventilating Exposition, New York. Charles F. Roth, Manager, International Exposition Co., Grand Central Palace, New York.

HEAT BALANCE IMPROVED—
Operating and Investment Cost Reduced

WITH

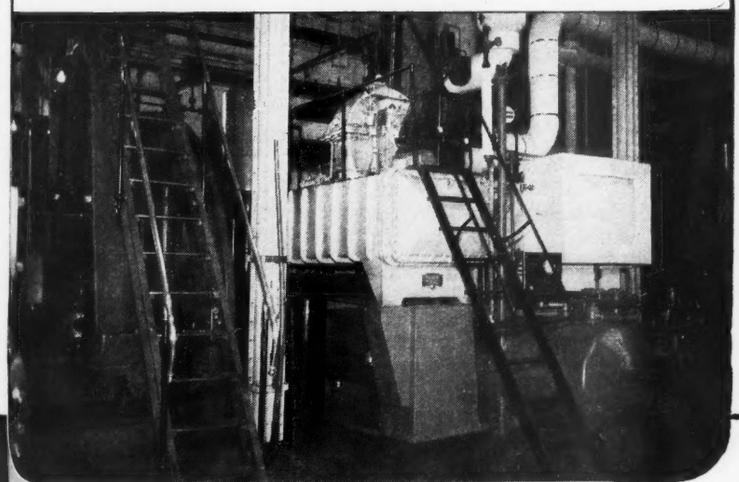
Carrier Centrifugal REFRIGERATION

1 **SIMPLE!** No electric drive reciprocating machine is necessary here! A simple steam turbine, using live steam from the boilers, provides direct drive for the Carrier Centrifugal Compressor, and eliminates losses due to electric power generation and transmission. Clean and untainted from oil, the exhaust steam is used in processing.



Direct Drive Makes Costly Generators Unnecessary for Refrigeration at Narragansett Brewing Company

2 **COMPACT** is the word for the Carrier Centrifugal Compressor! To get a good idea of the space it requires, compare this picture with the one preceding, showing the reciprocating machine it replaces.



Makes Savings with Reduced Investment

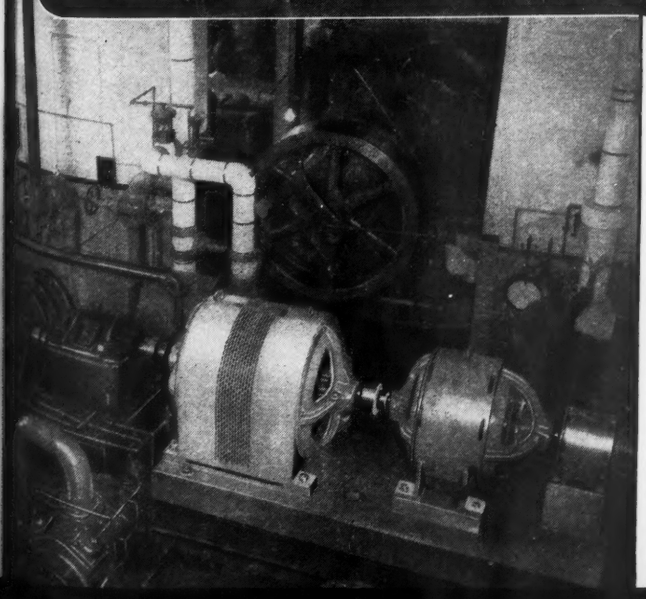
THE installation of steam turbine driven Carrier Centrifugal Refrigeration in this Providence, R. I. brewery is a good example of the economies that can be secured wherever refrigeration is required—for processing or for air conditioning.

First of all, the investment cost is definitely lower—for no electric driven reciprocating machines are necessary, and the size of generators required for plant power is greatly reduced.

Second, the system makes full use of all steam—for the exhaust steam is clean and free from oil and can be used for all plant processing. This feature made it unnecessary for the Narragansett Brewing Company to enlarge its existing boiler capacity.

Lastly, the system requires less space and less attention. Using a low pressure harmless refrigerant, the Carrier Centrifugal operates at conservative speeds, picks up loads almost instantly, and meets all varying load conditions. A minimum of moving parts insures long, trouble-free service.

An interesting new booklet tells more of the features of direct drive Carrier Centrifugal Refrigeration—send for it.



3

LOW POWER COSTS throughout the plant are assured with a set-up like this—and it's all a part of the heat balance made possible by Carrier Centrifugal Refrigeration. Only a fraction of the size of the equipment it replaces, this mixed pressure bleeder, type turbine and dual generator unit supplies both AC and DC power, and also provides clean exhaust steam for processing. Why install large, costly generators — when smaller ones supply all the electric power required, more efficiently—more economically?

CARRIER CORPORATION, Desk 1008
Syracuse, N. Y.

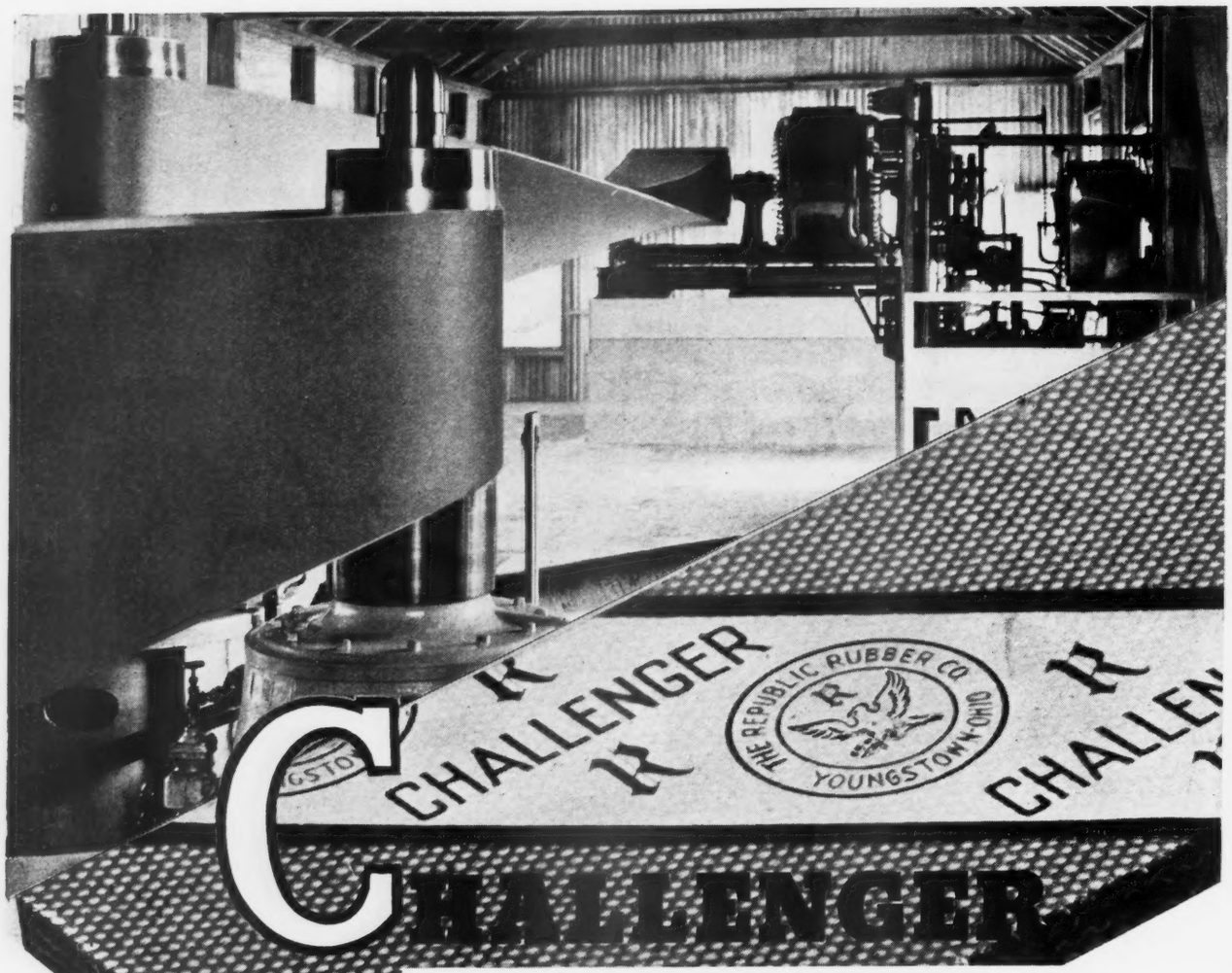
Without obligation, send me free copy of your booklet, "Carrier Centrifugal Refrigeration—for New Plants, for Additions, for Replacements."

Name..... Title.....

Company.....

Address.....

City.....



A GREAT BELT FOR STOPPING POWER LEAKS

REPLACE your power-leaking belts on heavy duty or high speed transmissions with Challenger and the power savings will soon pay its cost. Challenger is a powerful, pulley-gripping belt that provides smooth, even tension with minimum slippage and transmits maximum force from one pulley to another. Its extreme low stretch holds that power-saving tension over long periods without take-up. You not only get highest grade transmission but also a marked reduction in belt cost.

Challenger is only one of many grades of Republic Transmission Belting —each built for a particular type of service. Ask any Republic Distributor in your locality for details or write for bulletin "Reduce Power Costs."

REPUBLIC RUBBER

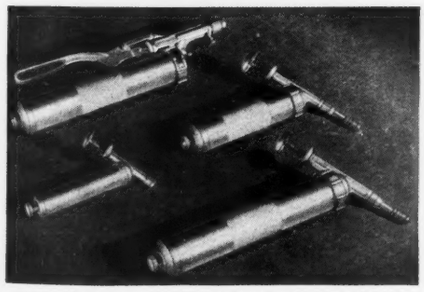
Division OF LEE RUBBER AND TIRE CORPORATION

YOUNGSTOWN, OHIO

Manufacturers of HOSE
BELTING • PACKING
MOLDED PRODUCTS

ORDER REPUBLIC RUBBER PRODUCTS FROM YOUR DISTRIBUTOR

Model 246 Electric Lubrigun



A few of the many types of hand operated Lincoln Grease Guns are shown above. The complete line is shown in Catalog No. 60

Glass Manufacturer Finds
LINCOLN LUBRICATING EQUIPMENT
is real solution to problem of lubricating bearings of transfer car that carries 20 tons

• Sure, your problems are different—or are they? In either case, we are confident that there is Lincoln Equipment available to solve any grease lubrication problem in your plant.

It is very probable that you will find some of our standard units ideally suited for your requirements. Such was the case in the installation shown above. Our Model 246 (illustrated at left) proved to be ideal for properly lubricating the transfer car of a well known glass manufacturer. After becoming familiar with our unit, the manufacturer agreed that the solution of his lubrication problem, like his product, was "clear as crystal."

If you have machinery that requires periodic greasing, you undoubtedly can save time and money by installing Lincoln Lubricating Equipment.

The complete Lincoln industrial line is illustrated and described in Catalog No. 60—and a copy is yours for the asking.

LINCOLN ENGINEERING COMPANY
PIONEER BUILDERS OF LUBRICATING EQUIPMENT
GENERAL OFFICES, ST. LOUIS, MO. FACTORIES: ST. LOUIS, MO., DETROIT, MICH.

Serving today's needs by anticipating tomorrow's

For over half a century Thermoid has followed this policy that today's demands can be best met by anticipating the increased demands of the future.

What better illustration than Thermoid Steam Hose? Made from specially compounded rubber with a thick inner tube built to resist the deteriorating action of steam under pressure. It is reinforced with plies of tightly woven, non-expanding fabric and then covered with a heavy layer of high quality, heat-resisting rubber.

Whether you are handling air, water or steam, specify the pressures and Thermoid will supply the one hose, best suited for your particular need.

Our catalog giving full specifications on all Thermoid Hose for every industrial need will be gladly sent upon request. Thermoid Rubber, Division of Thermoid Company, Trenton, N. J.

Thermoid

HOSE · V AND FLAT BELTS · PACKINGS · BRAKE LININGS

SOMETHING *Can* BE DONE ABOUT YOUR POWER COSTS!

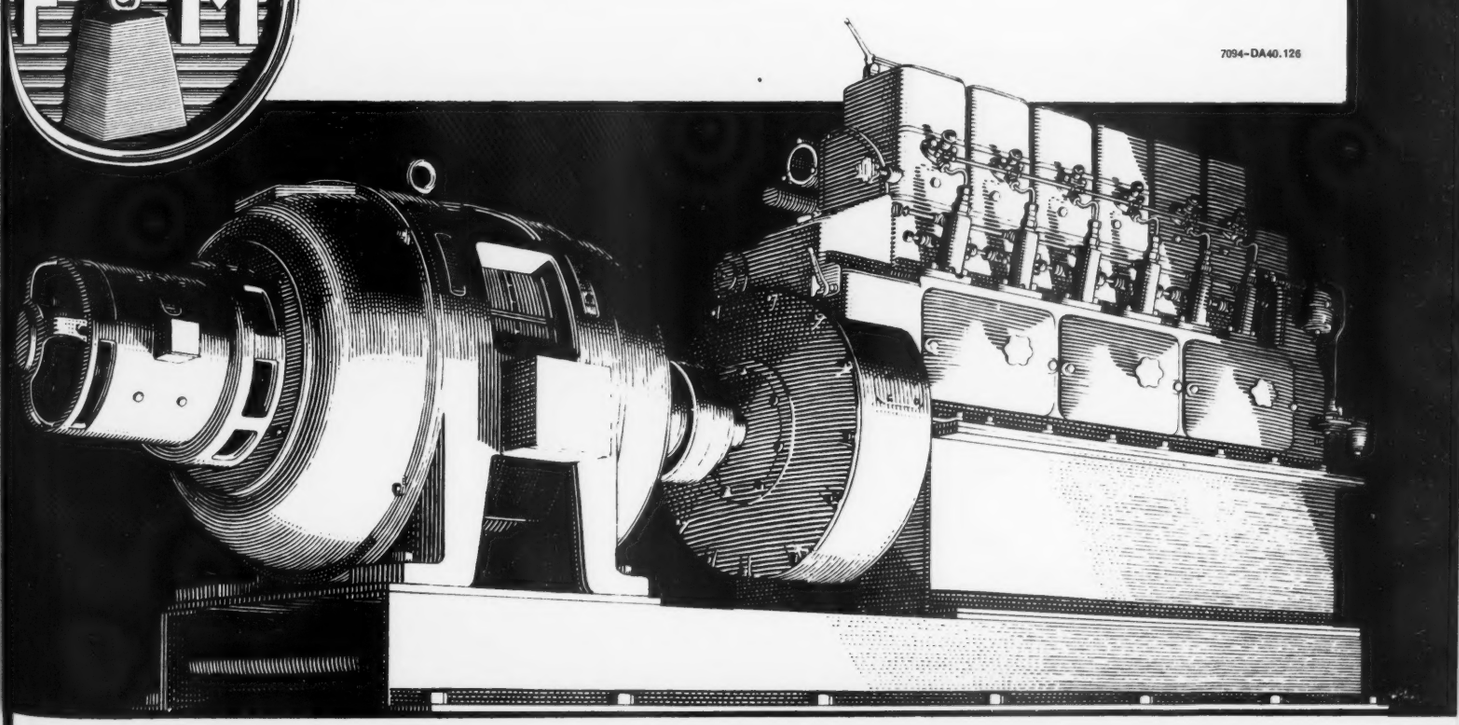
● A Diesel provides the most efficient way to make power out of fuel. Its efficiency averages double that of any other prime mover. In addition, a Diesel uses the lowest cost fuel that is available in a convenient form for automatic operation.

Almost without exception, a thorough investigation proves that a Fairbanks-Morse Diesel will cut power costs, as well as provide independence from all outside circumstances. You pay only for the power you actually use—no premium for peak-load generating capacity required to serve the community as well as yourself.

The Fairbanks-Morse Model 36 Diesel Generating Set is one of the most popular choices of plants requiring comparatively small capacity, as well as of manufacturers in need of flexible, economical power.

Do not put off your investigation of power costs any longer. Write for Bulletin 3600, Fairbanks, Morse & Co., 900 S. Wabash Avenue, Chicago, Ill. 34 branches at your service throughout the United States.

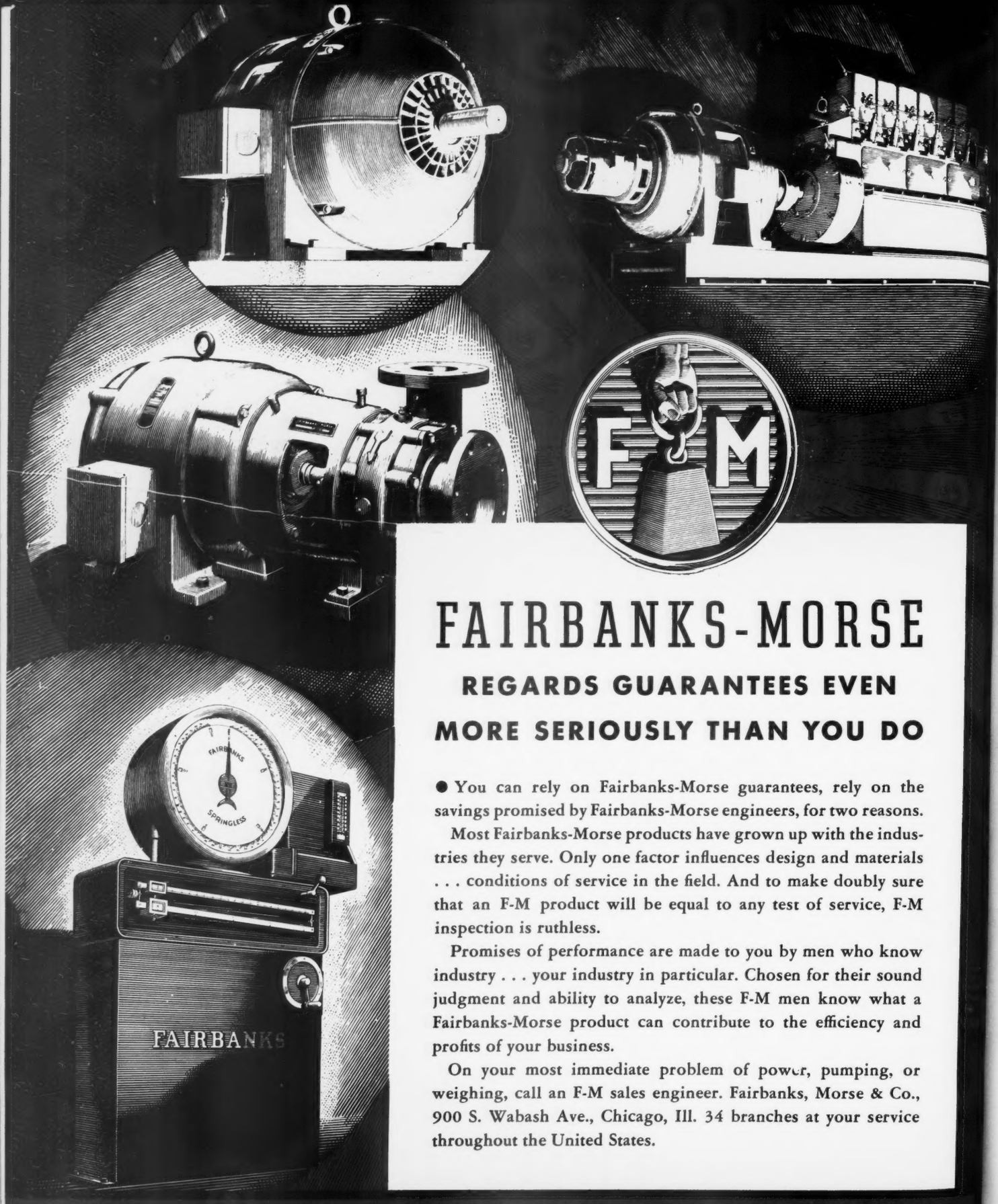
7094-DA40.126



FAIRBANKS MORSE

DIESEL ENGINES — REFRIGERATORS
PUMPS — RADIOS
ELECTRICAL MACHINERY — WASHERS
FAIRBANKS SCALES — FARM EQUIPMENT
RAILROAD EQUIPMENT — STOKERS
OIL SYSTEMS — AIR CONDITIONERS

Diesels



FAIRBANKS-MORSE

REGARDS GUARANTEES EVEN MORE SERIOUSLY THAN YOU DO

● You can rely on Fairbanks-Morse guarantees, rely on the savings promised by Fairbanks-Morse engineers, for two reasons.

Most Fairbanks-Morse products have grown up with the industries they serve. Only one factor influences design and materials . . . conditions of service in the field. And to make doubly sure that an F-M product will be equal to any test of service, F-M inspection is ruthless.

Promises of performance are made to you by men who know industry . . . your industry in particular. Chosen for their sound judgment and ability to analyze, these F-M men know what a Fairbanks-Morse product can contribute to the efficiency and profits of your business.

On your most immediate problem of power, pumping, or weighing, call an F-M sales engineer. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 branches at your service throughout the United States.

FAIRBANKS - MORSE

Power, Pumping, and Weighing Equipment

107 YEARS OF PRECISION MANUFACTURING

STEP FORWARD TO BETTER GRATING

BLAW-KNOX *Electroforged* STEEL GRATING

THIS FREE SAMPLE WILL CONVINCE YOU

FIVE Points of Superiority

- ★ Electroforged, one piece construction—strongest by test.
- ★ Safest footing because of the twisted bar.
- ★ Self-cleaning, no sharp corners to clog with debris.
- ★ Maximum open area for light and air.
- ★ Easily maintained. No cracks or crevices; paint reaches entire surface.

SEND FOR IT

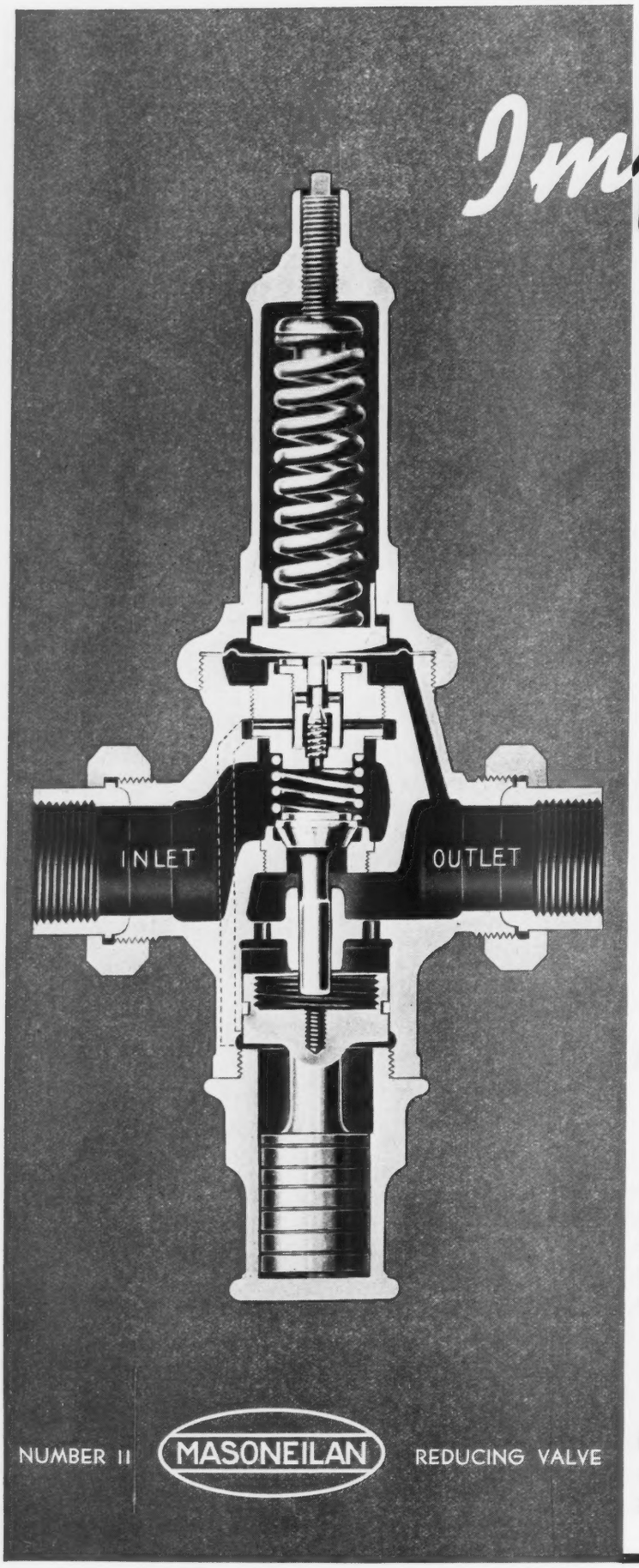
BLAW-KNOX COMPANY, 2031 FARMERS BANK BUILDING, PITTSBURGH, PA.

Send Grating Sample to

NAME_____ COMPANY_____

STREET_____

CITY_____ STATE_____



NUMBER 11 MASONEILAN REDUCING VALVE

Important

FEATURES THAT MEAN ECONOMY IN STEAM PRESSURE CONTROL

EXACT CONTROL of saturated or superheated steam even though initial pressure and load fluctuate. Pilot operation insures sensitiveness to minute reduced pressure variations and provides streamlined flow. SAVES FUEL.

STAINLESS STEEL TRIM is standard. Renewable, stainless steel pilot and main valves and seats heat treated, *for extreme hardness*, are highly resistant to erosive action of steam; pilot valve, main valve, piston and cylinder are machine ground and highly polished to minimize adherence of boiler compound deposits. SAVES MAINTENANCE COST.

ADJUSTABLE over a wide range without changing springs. Reduced pressure set by means of removable key—prevents tampering. SAVES TIME.

Complete line available including bronze bodies sizes ½" to 2"—pressures up to 250 lbs.; iron bodies sizes 2" to 4"—pressures up to 250 lbs.; steel bodies sizes ½" to 4"—pressures up to 400 lbs.

Write for Catalog No. 63 which describes the full line of Masoneilan Regulators.

MASON-NEILAN REGULATOR CO.
1194 ADAMS STREET, BOSTON, MASS.
New York Philadelphia Pittsburgh Chicago
St. Louis Tulsa Houston Los Angeles

THE NEW
SILENT STEEL
SPECIAL DUTY

Bassick
TRUCK CASTERS

SERIES "99"
with 3"-4"-5"-6"-8" Diameter Wheels

Another outstanding development in truck casters ... by BASSICK. Long life, easy swiveling and quietness are fused into this new "99" series.

Projection welding makes possible these highest quality precision assemblies with only *three* parts. There are no rivets ... no parts to loosen and cause sloppy action or caster failure. Rigid casters are available to match the swivel.

Write for THE NEW BASSICK CATALOG No. 120

THE BASSICK COMPANY • BRIDGEPORT, CONNECTICUT
THE WORLD'S LARGEST MANUFACTURER OF CASTERS AND FLOOR PROTECTION EQUIPMENT

SPRAY GUNS

MATERIAL CONTAINERS

REGULATORS

SPRAY BOOTHS

EXHAUST FANS

HOSE AND CONNECTIONS

AIR COMPRESSORS

ACCESSORIES

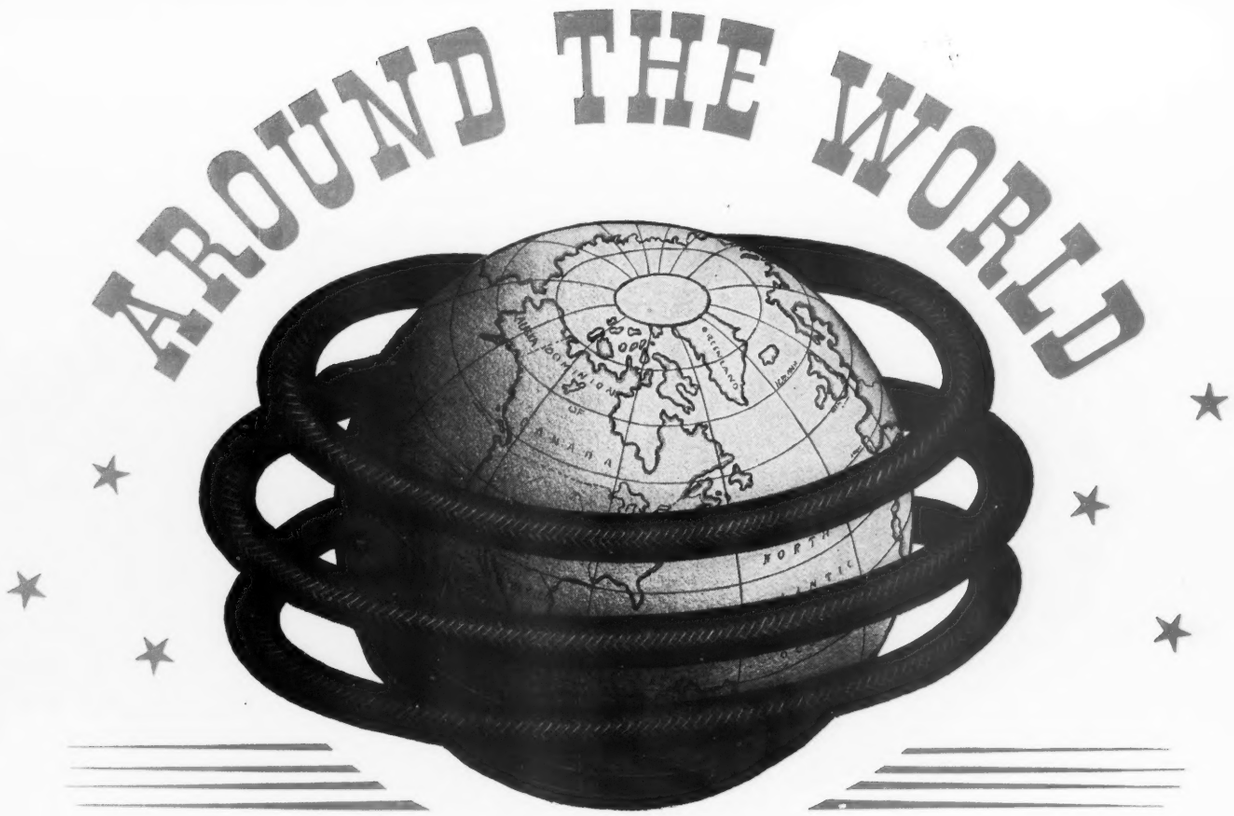
DeVilbiss

Included in the comprehensive DeVilbiss System is a complete line of portable equipment for the maintenance painting of industrial buildings, structures and equipment. This line includes portable outfits to meet every painting need—from light duty outfits for small painting jobs up to heavy duty outfits for major painting operations.

Spraying offers many advantages over old-fashioned maintenance painting methods. Spraying is faster, more efficient, more economical. It produces better paint jobs in less time, with minimum interruption of regular work. Sprayed coatings last longer and are easier to clean. Any surface can be sprayed, and DeVilbiss Equipment sprays all painting materials with equal facility.

This line of portable spray-painting equipment, complete though it be, is only part of the broad DeVilbiss System—a system so all-embracing that it includes everything needed in every form of modern spray-painting and spray-finishing. However, should you have a problem so individual that it cannot be met by the equipment in the standard DeVilbiss line, our engineering and research departments are always available to plan a special installation exactly suited to your particular needs.

THE DeVILBISS COMPANY • TOLEDO • OHIO



WHERE LASTING SERVICE IS PARAMOUNT
DELTABESTON IS ALWAYS USED

No wonder maintenance men and engineers choose Deltabeston Wire and Cable! It has proven its mettle, time after time. No job is too hot . . . no job too strenuous . . . for Deltabeston. Exclusive Purified, Felted Asbestos Insulation insures day after day service under the most trying conditions. Power Cable . . . Motor Lead Cable . . . Magnet Wire . . . there is a Deltabeston Asbestos Insulated Conductor for every kind of application.

For the sake of your equipment and the work that you want it to do . . . investigate the complete, dependable line of Deltabeston Wires and Cables. Subject it to any sort of a test . . . confront it with any kind of a heat problem. Deltabeston does the job with flying colors.

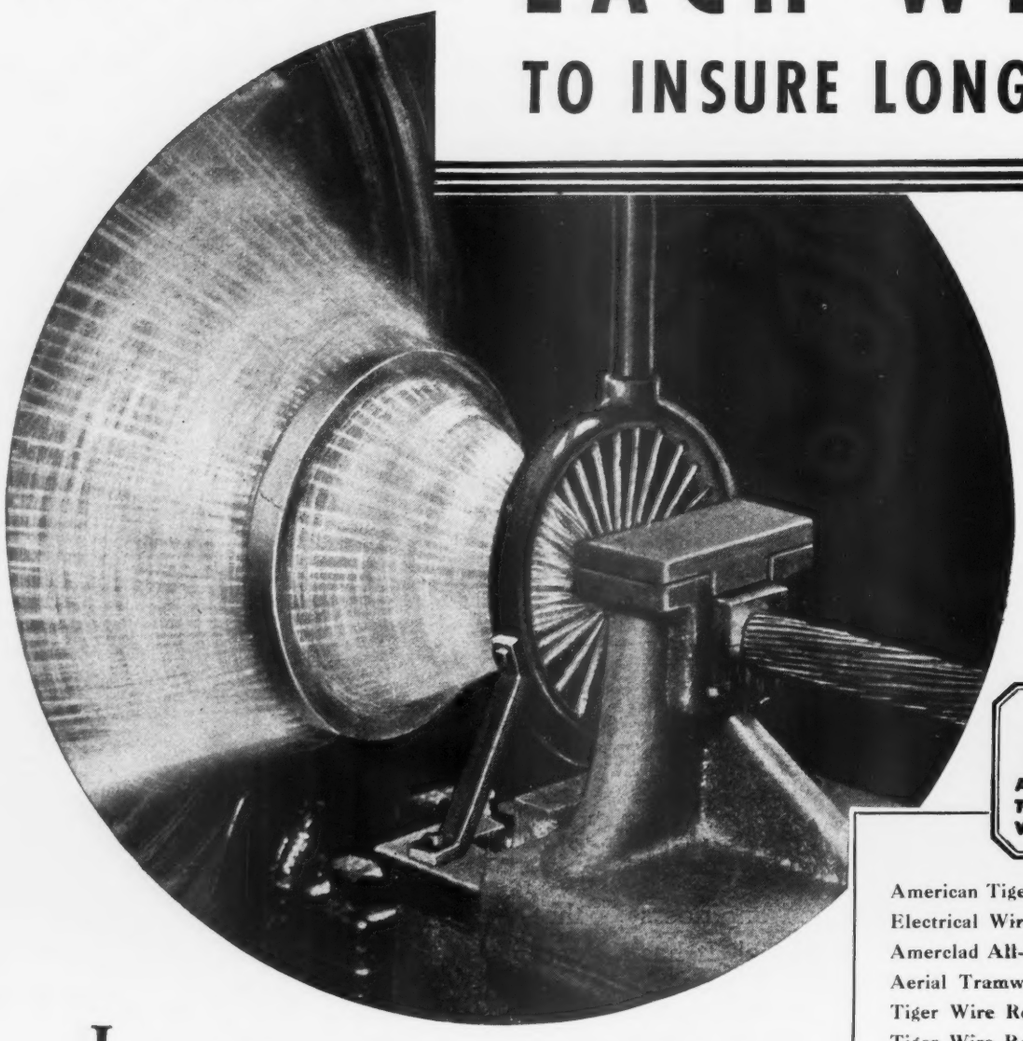
Write to Section **Y-9611**, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn. Deltabeston Wire and Cable is distributed nationally by General Electric Merchandise Distributors and the Graybar Electric Company.

GENERAL ELECTRIC

DELTABESTON WIRE AND CABLE

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

We lubricate EACH WIRE TO INSURE LONG LIFE



AMERICAN TIGER BRAND WIRE ROPE

American Tiger Brand Wire Rope
Electrical Wires & Cables
Amerclad All-Rubber Cables
Aerial Tramways
Tiger Wire Rope Slings
Tiger Wire Rope Clips

LUBRICATION at each point of contact in wire rope is of equal importance to that in any complicated machines*. It reduces external wear, prevents corrosion, cuts down internal friction and enables each strand to move freely — all of which results in increased useful life.

Every wire of American Tiger Brand Wire Rope is carefully lubricated. This adds vitally to the flexibility of the rope, enabling it to withstand the terrific jerks of starting and stopping.

This lubrication is the result of years of engineering and field experience and is but one of the many different features which make American Tiger Brand Wire Rope a profitable operating investment for you.

American Tiger Brand Wire Rope is available in either Standard (non-preformed) or Excellay (preformed) constructions.

*** Machines? Absolutely, wire rope is a machine. It fits perfectly the dictionary definition, "Any combination of mechanism for utilizing or applying power."**

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
Russ Building, San Francisco

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

STORY IN PICTURES

This 24-page book, "Grinnell Prefabrication", shows many installation views, explains the economy in cost and labor, easier erection, pretesting, qualification for insurance and other advantages of Prefabrication by Grinnell. Write for your copy to-day.

The complicated structure of these 12″ and 20″ low pressure and exhaust headers offers an excellent example of the interpretive engineering that is an important feature of *prefabrication by Grinnell.*

Grinnell engineers worked closely with the designers of the big power plant in which this piping is located. Interpreted their ideas and plans in terms of extruded outlets, circumferential welds, *simplicity.*

Interpretive engineering is only one of the eight reasons why engineers on routine or pioneering power or process installations say "Give the plans to Grinnell". Grinnell Company, Inc., Executive Offices, Providence, R. I., Branch offices in principal cities of the U. S. and Canada.

PREFABRICATION BY GRINNELL

WHENEVER PIPING IS INVOLVED

When is a Customer Satisfied?

Satisfied customers are the foundation of any business. Meeting a specification or a delivery date helps, but these are only a start.

Here at Industrial Brownhoist, we believe that a customer should be satisfied only after years of dependable and profitable operation from the crane we sell him. This involves many things—design, construction and even our selling methods—for it means that our locomotive or crawler crane must prove itself the most economical unit for doing your particular kinds of handling work.

This slow, but sure, method of building customer good-will is responsible, in our case, for the world's most complete line of locomotive cranes. It is responsible, too, for the unusually high regard in which the name Industrial Brownhoist is held wherever materials are handled.

Are you satisfied with your present material handling costs? If not, we would like you to be one of our kind of customers.

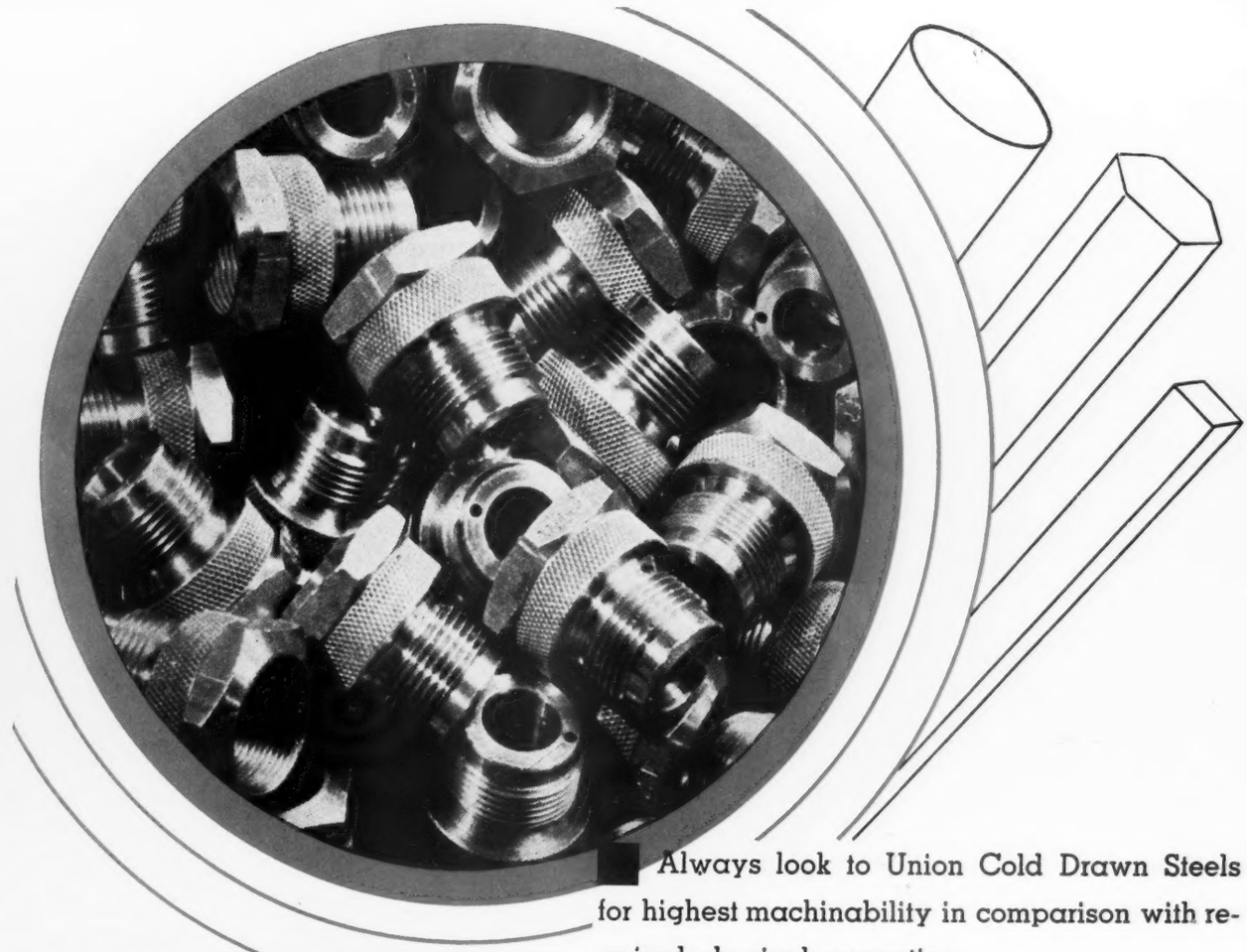
INDUSTRIAL BROWNHOIST CORPORATION, BAY CITY, MICHIGAN

District Offices: New York, Philadelphia, Cleveland, Chicago

Locomotive Cranes
Crawler Cranes
Erection Cranes
Wrecking Cranes

INDUSTRIAL BROWNHOIST

Bridge Cranes
Pile Drivers
Dock Machinery
Buckets



Easier to Machine Because the Steel is UNION COLD DRAWN

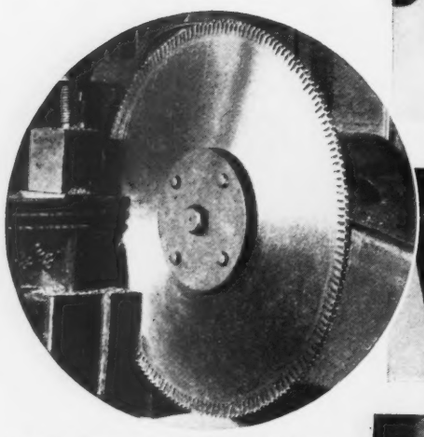
Always look to Union Cold Drawn Steels for highest machinability in comparison with required physical properties.

This superiority has been accomplished by a long series of improvements in Union Cold Drawing processes. An important step in this progress has been the practical elimination of abrasive elements from Bessemer steels. Careful control of furnace operations and vigilance in checking steel analyses also play important parts in obtaining high grade cutting properties.

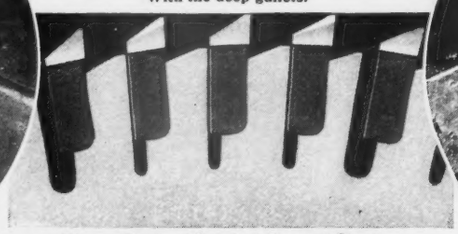
Specify Union Drawn Bars on your next cold drawn steel order and profit by the advantage of lower machining cost. A Union Drawn Distributor in your locality is prepared to make quick delivery.

Union *Cold Drawn* Steels

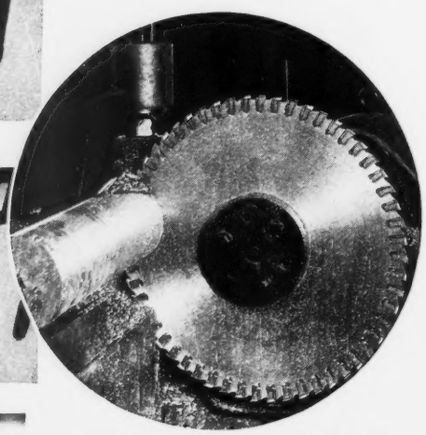
Disston Improved Interlock Inserted-Tooth. With the deep gullets.



Disston Sectional Interlock Inserted-Tooth Saw. For cutting steel rails, irregular shapes, risers from steel castings, and all work that requires close tooth spacing.

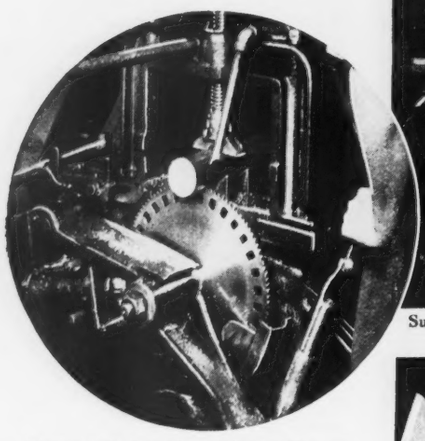


Disston Sectional Interlock Inserted-Tooth.

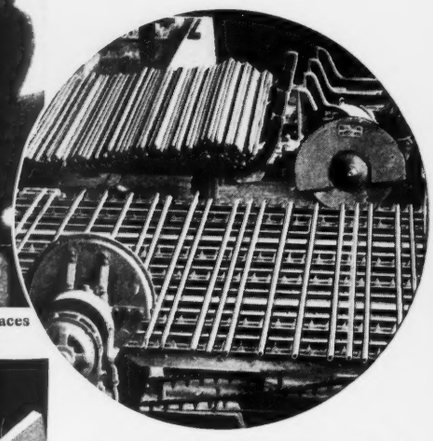


Disston Improved Interlock Inserted-Tooth Saw. For cutting large, heavy forgings, castings, rounds or squares, and all work that does not require close tooth spacing.

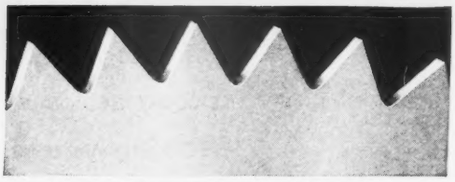
Superiority of Cutting Steels from Disston Furnaces Today Typifies America's Industrial Progress.



Disston Solid-Tooth Metal-Cutting Circular Saws. For all purposes and machines. High-speed steel, semi high-speed, high-carbon, special steel for cutting brass, type metal, etc.



Disston Tube-Cutting Circular Saws. Made with or without expansion slots. Accurately ground and balanced. Correctly tensioned. Noted for high-speed operation and efficiency.



Disston Hot Saws designed for high-speed sawing of hot metals. Teeth milled, not punched. Hollow ground for accuracy.

Cut It with Disston Steel

Disston steel was originated as *cutting* steel! It is steel famous for its part in the building of America . . . steel distinguished for service rendered in American industrial progress. So, today, Disston steel in saws, tools, files, marches ahead—meeting industry's needs on every cutting job.

All Disston experience, laboratory research, experiment, is yours to use. Write us what you cut. Let us co-operate with you, to improve production and cut costs. Henry Disston & Sons, Inc., 1124 Tacony, Philadelphia, U. S. A. *Branches:* Boston, Chicago, Detroit, Memphis, New Orleans, Seattle, Portland, Ore., San Francisco, Vancouver, B.C. *Canadian Factory:* Toronto.

DISSTON METAL-CUTTING
Circular Saws

FREE - Metal-Cutting Manuals: "Circular Saws", "Band Saws", Hack Saws", "Files". Write address below, clip and mail to Disston, 1124 Tacony, Philadelphia, U. S. A.

"Can there really be so much difference in belts?"

YES!

there can . . . there *is* . . .

and here's why:

Take the finest "heavy" hides the world produces; treat them by the exclusive VIM process to preserve the long, tough fibers . . . There, to begin with in VIM BELTS, you have the finest belting material known .... flexible, resilient, unaffected by moisture, oil, or dirt.

Couple this with the VIM patented surface tread. Now you have a belt with a higher coefficient of friction .... a surer, positive grip, a matchless endurance.

That's why VIM TRED delivers nearer 100% of the power . . . why in practical, comparative tests, it has actually carried as high as 250% of its rated capacity.... even at low tensions.

Thus you get, as VIM BELT users do: Lower maintenance and operating costs .... greater production .... increased profit. Clearly it pays you dividends to use VIM TRED BELTING.

That's why we urge you to give it a trial!

The structural requirements of any good belt and belt drive are discussed in a booklet entitled, "How to Belt Your Drives for More Profit." Send for this booklet. It is to your advantage to read it, and it is free.

E. F. HOUGHTON & CO.
Chicago - PHILADELPHIA - Detroit

VIM TRED
LEATHER BELTING

Norton Wheels
for
Centerless Grinding

Alundum Wheels

IF you are grinding steel or steel alloy parts, you should try the Norton Alundum Wheel with the new "B-E" bond. This wheel is showing such uniformly successful results — faster, cooler cutting, longer life, fewer dressings—that we are confident it is well worth a careful trial on your jobs.

Crystolon Wheels

For parts of brass, bronze, aluminum, cast iron and non-metallic materials such as glass, rubber and carbon there are Norton wheels of hard, sharp Crystolon abrasive — Wheels that have the same fast, cool cutting action on these materials that "B-E" bond Alundum wheels have on steels.

Regulating Wheels

Norton rubber bonded wheels for regulating or feeding the work are as popular as Norton wheels for grinding. They have the necessary strength to resist the pressure of holding the work against the grinding wheel which means fewer dressings. They have the proper surface friction to rotate the work without marring its surface.

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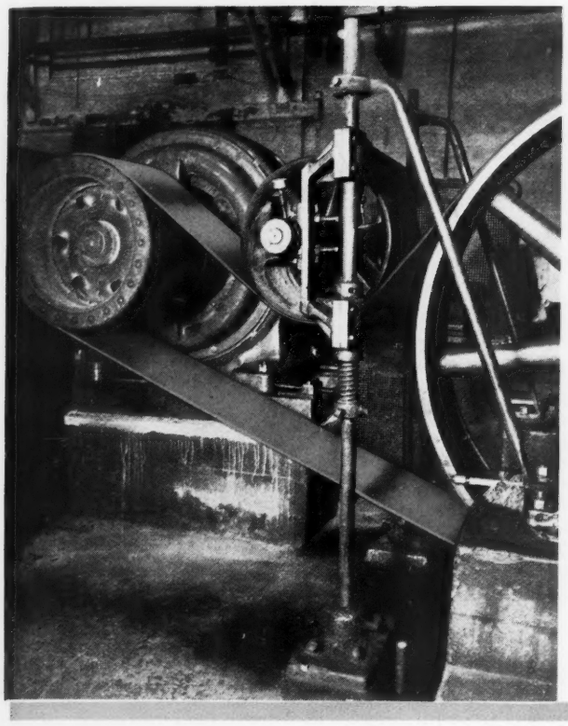
W-597

NORTON ABRASIVES



On *Any* Drive
Rhoads TANNATE Leather Belts
Give You Longer Service,
Larger Output and Lower Costs!

THE Rhoads TANNATE Belt shown at the left has been in steady use for four and one-half years . . . still good . . . still giving excellent, trouble-free service. Eighteen months was the usual belt life on this short-center, idler drive before the TANNATE Belt was installed.

But on most short-center drives idlers are discarded when TANNATE Belts are used. Their greater power-transmitting capacity, flexibility and grip are assured by the special processes used in making them.

TANNATE Belts are *not* ordinary belts. They are specifically made to deliver to you more power, longer life, more production and lower maintenance costs. Hundreds of satisfied industrial plants have *proved* these facts. Write TODAY for full information about TANNATE Leather Belting—or, ask to have a Rhoads salesman call!

RHOADS TANNATE

J. E. RHOADS & SONS

Established 1702

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NEW YORK, 102 Beekman Street — ATLANTA, 88 Forsyth Street, S.W.
CHICAGO, 26 N. Clinton Street — CLEVELAND, 1200 W. Ninth Street
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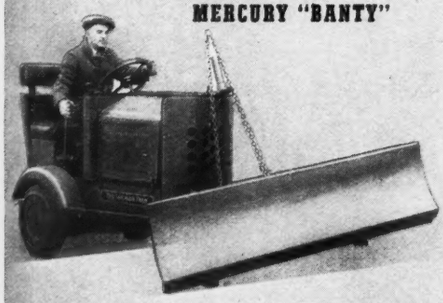
RHOADS TANNATE

MERCURY "HUSKIE"

A versatile 4 wheel tractor capable of handling heavy loads and adapted to work indoors or out.

MERCURY "BANTY"



The smallest 3 wheel gas tractor built, with ample power and speed for industrial hauling.

SNOW REMOVAL
ANOTHER JOB FOR THE 'HUSKIE' OR 'BANTY'

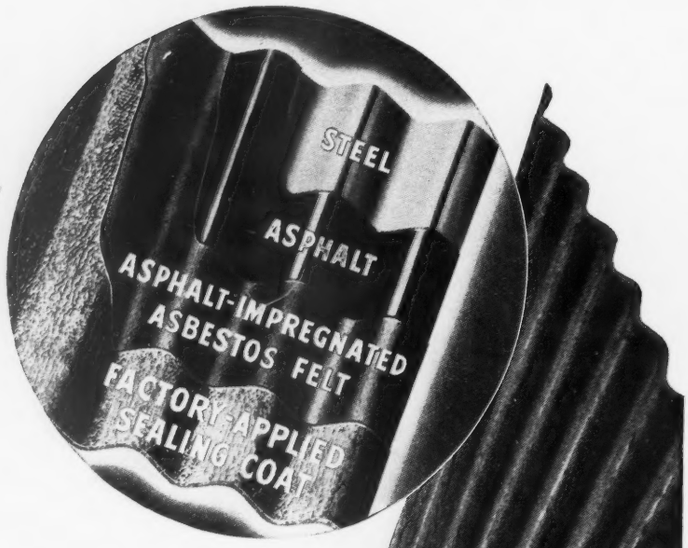
Protect your operations against costly interruptions in intra-plant haulage during the approaching winter months. The "Huskie" and "Banty," both rugged, powerful and compact industrial tractors, are now available with plow attachments which facilitates the quick, efficient removal of the heaviest snow falls. Runways and sidewalks cleared, the plow attachment is easily removed and the tractor put back to routine haulage service. Now is the time to make preparations for the winter months Complete specifications on the "Huskie" and "Banty" and snow plows will be mailed upon request.

Mercury Manufacturing Company
4110 South Halsted Street · Chicago

MERCURY TRACTORS · TRAILERS LIFT TRUCKS

Here's the Inside Story

of Years of Trouble-Free Roofing Service!



LOOK at this illustration of a cut-away section of Robertson Protected Metal Roofing! You can readily see why it gives so much service . . . at such low cost. Here are special protective coating of asbestos felt, and asphalt, sealed on a core of high-tensile-strength steel by Robertson's exclusive weatherproof surface.

Corrosion meets defeat, when it encounters this surface . . . and maintenance costs go down! Robertson Protected Metal successfully resists the attacks of chemicals, salt air, erosion and fumes. It protects your building against the hazards of fire. It is high in insulating value, exceptionally light and easy to install.

Robertson Roofs last for fifteen, twenty . . . and more years . . . giving dependable service continually. And in practically every country in the world, R.P.M. has proved to be the most economical roofing obtainable per year of service. To get the complete story of R.P.M. Roofing and Siding, write for our booklet "Roofs Over Industry." Address your request to the H. H. Robertson Co., 2011 Grant Bldg., Pittsburgh, Pa.

Specially developed strap fasteners of Robertson Protected Metal make the installation job easier . . . leave no point in the Robertson Roof Unprotected.

ROBERTSON *Protected* METAL ROOFING

Suppose YOU DROVE A GEARLESS CAR—

THAT'S HOW SIMPLY THIS WELDER WORKS

From a slow creep to full speed in an instant—without shifting gears—with but one simple adjustment to give you any desired speed or power. That, in substance, is the principle upon which the P&H-Hansen Smootharc Generator operates. No matter what the job, what thickness of metal, what welding heat is desired, this remarkable generator instantly does everything required of it with one simple, foolproof control. Voltage regulation is automatic to supply the proper welding heat in each case.

SMOOTHARC WELDERS

SINGLE CURRENT CONTROL
. . . What It Means In Better Welding

By eliminating the usual complications caused by numerous gadgets, adjustments, etc., less responsibility is placed upon the operator. With the necessary high, open-circuit voltage assured at all times, you not only reduce the chances of failure but also save time and speed up the depositing of weld metal. Why not investigate the many outstanding features of Smootharc welders? Ask for a demonstration. Address the Harnischfeger Corporation, 4525 West National Avenue, Milwaukee, Wisconsin.

If You Weld Cast Iron, Test the New SMOOTHARC HARCAST Welding Electrodes

It's a new and better electrode for repair welding on cast iron. It's designed for successful low amperage welding; performs better at low current intensities and low voltages to protect against failures due to over-heating and radical changes in grain structure of cast iron. With proper application, the weld metal deposited by this electrode can be machined. Sizes $\frac{1}{8}$ inch and $\frac{5}{32}$ inch. Ask us to send you free samples.

HARNISCHFEGER CORPORATION

ARC WELDERS • EXCAVATORS • ELECTRIC CRANES P&H MOTORS • HOISTS • WELDING ELECTRODES

HARNISCHFEGER CORPORATION,
4525 West National Avenue,
Milwaukee, Wisconsin

Gentlemen:

Please send the following: (check which)

- ☐ Bulletin W-10, "The Arc Welding of Tomorrow" which describes the complete Smootharc Welder line from 75 to 600-ampere capacity.
- ☐ Free Samples of Smootharc D. H. Welding Electrodes for test purposes.
- ☐ Complete information on the line of Smootharc Welding Electrodes.

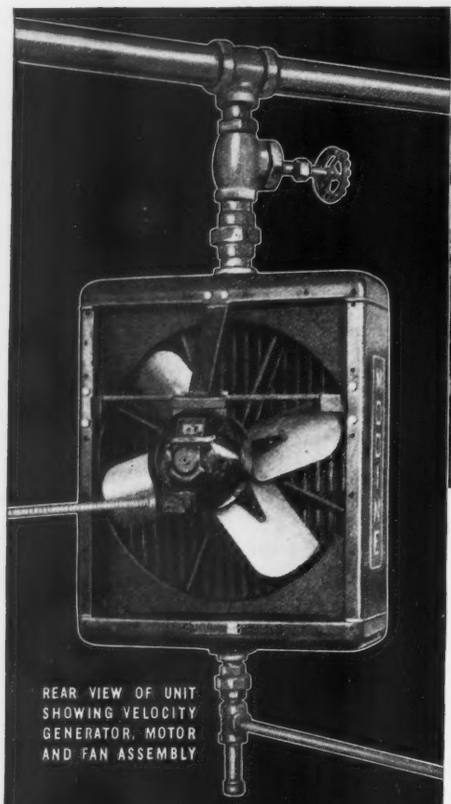
Name ..... Position.....

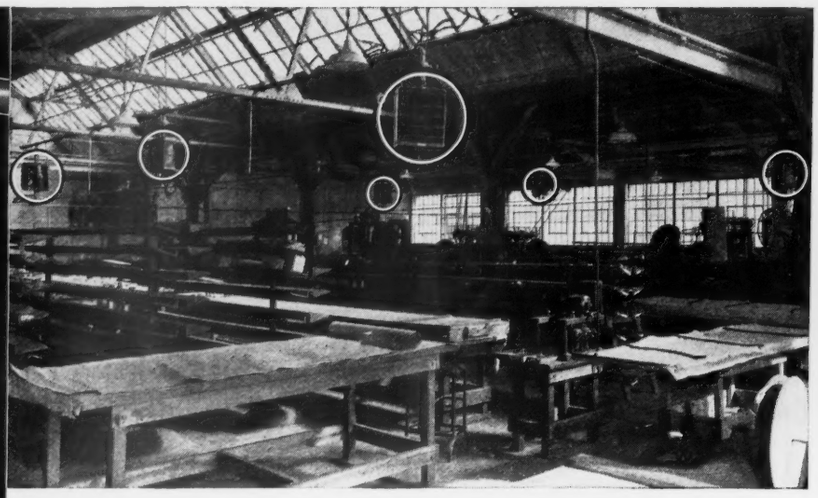
Company .....

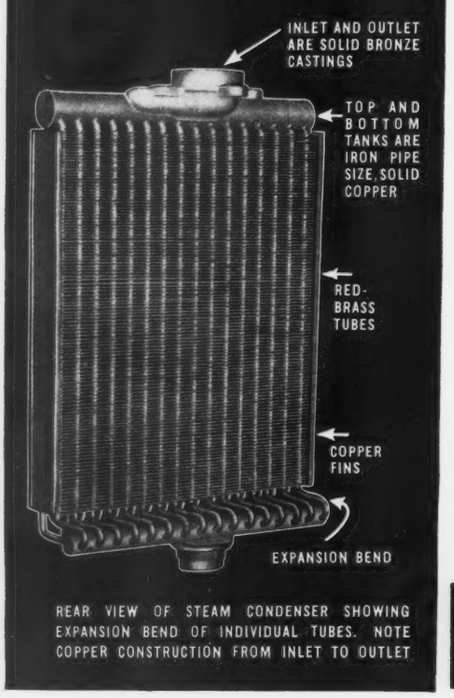
Street Address .....

City ..... State.....

Other people may make Unit Heaters . . . but they can't make MODINES






INLET AND OUTLET ARE SOLID BRONZE CASTINGS
TOP AND BOTTOM TANKS ARE IRON PIPE SIZE, SOLID COPPER
RED-BRASS TUBES
COPPER FINS
EXPANSION BEND

REAR VIEW OF STEAM CONDENSER SHOWING EXPANSION BEND OF INDIVIDUAL TUBES. NOTE COPPER CONSTRUCTION FROM INLET TO OUTLET

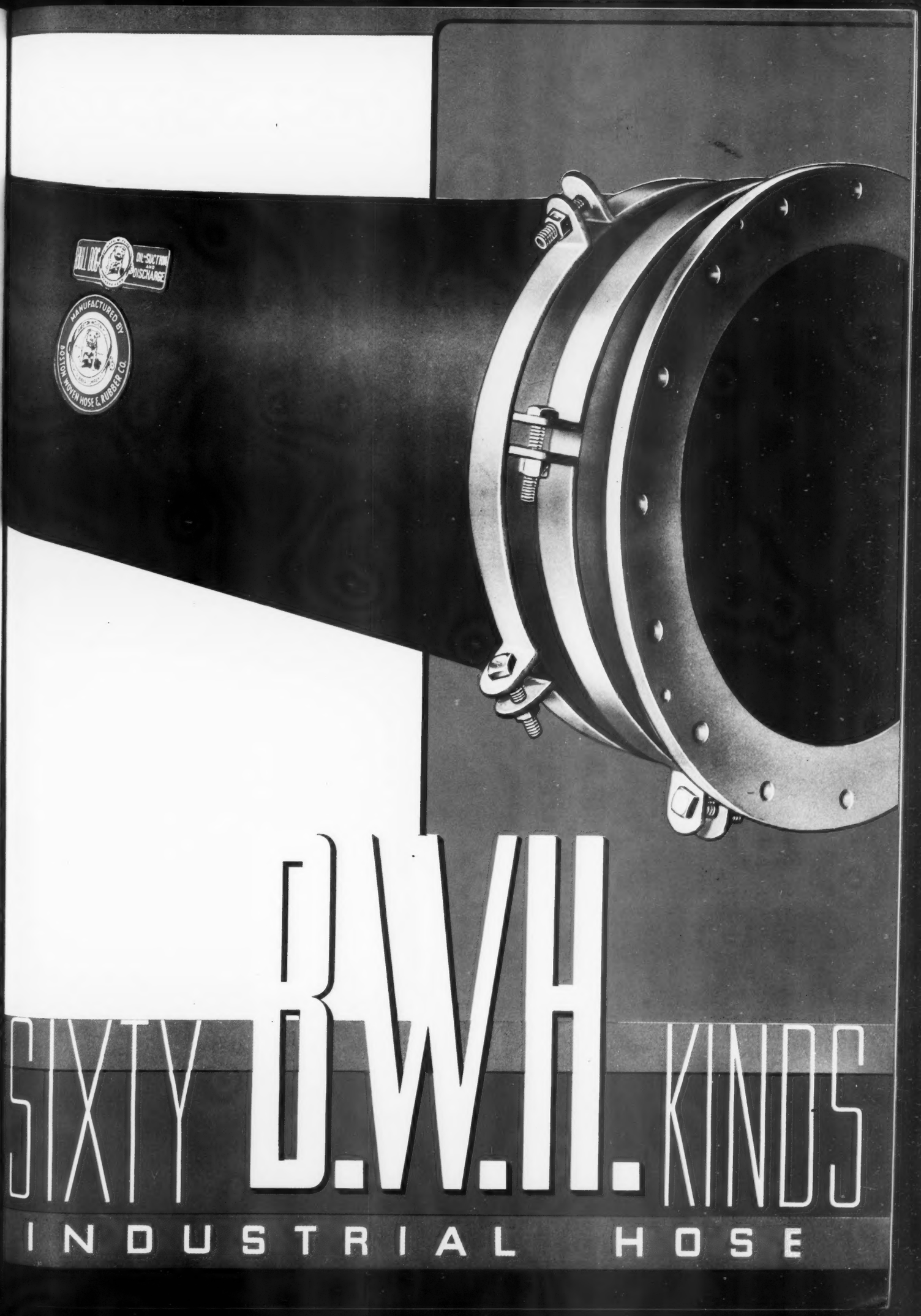
• There are other ways of heating your factory, but unit heaters are most modern, most efficient, and most economical. There are other makes of unit heaters—but exclusive Modine design, construction and performance superiorities make *Modine* the outstanding unit heater. And Modine faster, better heating, with greater fuel saving, has been repeatedly proven in thousands of installations.

The Modine condenser is far stronger structurally. Inlet, outlet, tanks, tubes, and fins are *all-copper or copper alloy.* All steam-carrying passages, *cylindrical* for excess strength, are welded and brazed into a single structure that *cannot leak* under high pressures or temperatures. *Expansion bend construction,* exclusively Modine, gives each tube knee-joint movement to expand or contract independently. The condenser design, plus *velocity generators* and other exclusive Modine air control features, assure far more effective and economical heat distribution. Fuel savings are 25% and more. Free book tells why *more Modines are being sold than any other unit heater.* Write for your copy.

MODINE MANUFACTURING COMPANY
1730 RACINE ST. • RACINE, WISCONSIN

Heating, Cooling and Air Conditioning Equipment for Industrial, Commercial and Residential Application

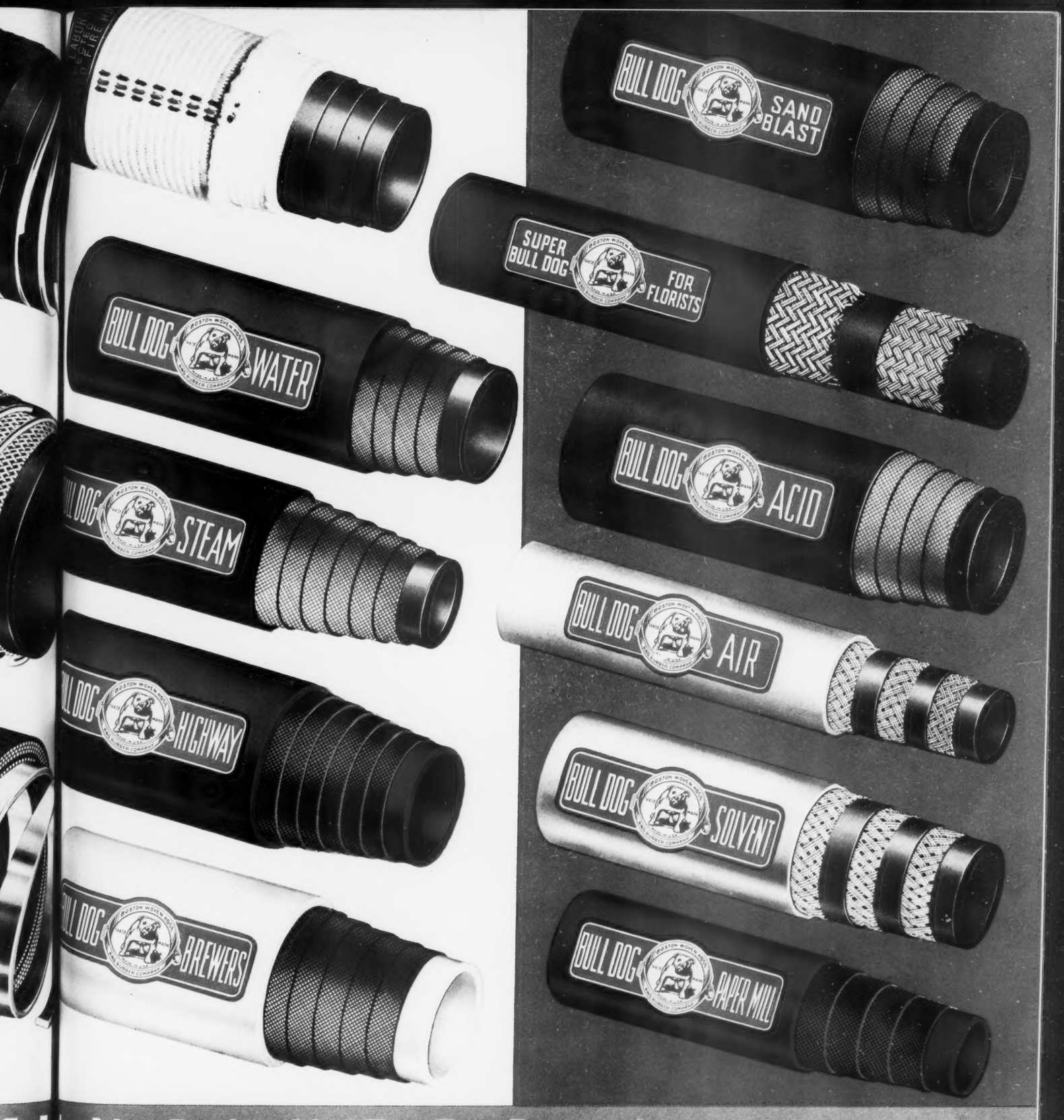
MODINE UNIT HEATERS


BULL DOG
OIL-SUCTION AND DISCHARGE
MANUFACTURED BY
BOSTON WOVEN HOSE & RUBBER CO.
SIXTY B.W.H. KINDS
INDUSTRIAL HOSE

THE BWH LINE OF HOSE

for EVERY

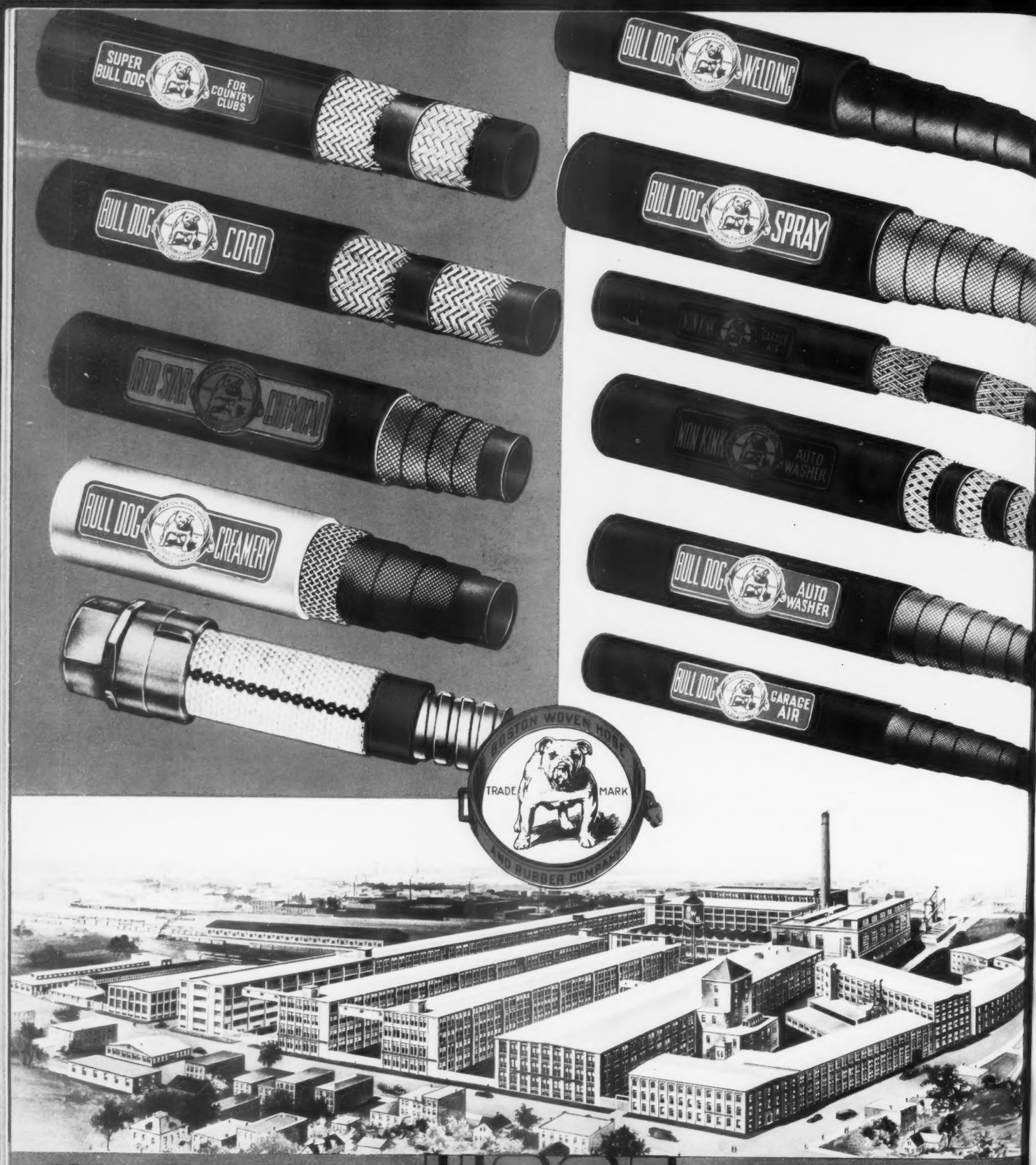
BOSTON WOVEN HOSE



S E I N C L U D E S A T Y P E

Y S E R V I C E

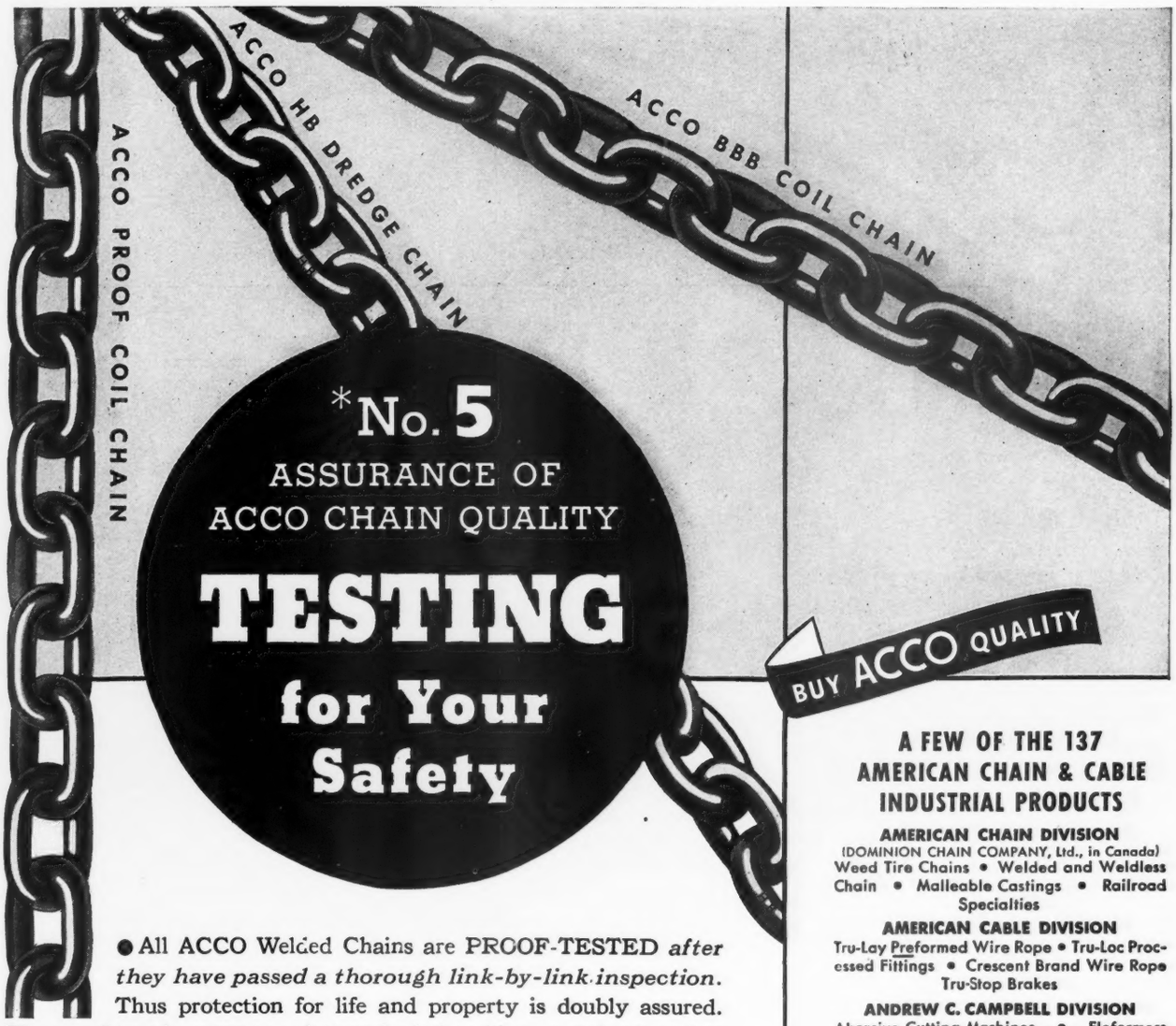
S E A N D R U B B E R C O M P A N Y



HOSE IS OUR HOSE MIDDLE NAM

BOSTON WOVEN HOSE AND RUBBER C

WORKS: CAMBRIDGE, MASS. P.O. ADDRESS: BOX 1071, BOSTON, MA



● All ACCO Welded Chains are PROOF-TESTED *after they have passed a thorough link-by-link inspection.* Thus protection for life and property is doubly assured. The proof test is assurance that each chain will carry a load greater than the recommended safe working load without distortion of the links or impairment of the shock-resisting properties of the chain.

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AMERICAN CHAIN & CABLE COMPANY, Inc.
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. . . IS A PROFITABLE PRODUCTION "TOOL"

More than 1,000,000 workers in every branch of industry—and their employers—are profiting through the use of this modern light source. This new "24-hour skylight" produces a soft, non-fatiguing light that reveals detail . . . promotes better work . . . and reduces rejects.

The new Horizontal Cooper Hewitt gives 22% more light from the same wattage. It starts instantly. It hangs horizontally to give the best, the most productive light distribution.

Light is a production "tool"; buy it as such. Have it engineered to fit your specific needs. Insist on mercury light. We will be glad to send a representative to survey your needs and recommend the most efficient installation for your particular requirement. General Electric Vapor Lamp Company, 815 Adams Street, Hoboken, New Jersey.

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Enthuse Over

QUINCY "Staying Qualities"

"It looks O. K. and the price is in line," says the long headed and experienced purchaser of plant equipment, "but how will it function three, five, ten years from now?"

That's a question we welcome. That basic matter of stamina, "guts" or whatever you care to call it, plus a unique standard of trouble-free, more-air-at-less-cost performance places Quincy Compressors at the top of the list.

That's the normal result of being air compressor specialists. Our entire efforts have always been exerted toward the single task of building FINER air compressors.

Let us send you the complete data you need to justify your decision to "Install a Quincy."

In the Filler Division of the Central Fibre Products Co. plant, makers of cardboard fillers for egg cases, a Quincy Model DA-27, 7½ H. P. air cooled compressor operates cleaning nozzles for blowing off machines and for paint spraying.

QUINCY FEATURES: Timken Roller Bearings ● Semi-Steel Pistons ● Balanced Drop-Forged Crankshaft ● Non-Breakable Steel Valves ● Perfect Circle Piston Rings ● Lynite Connecting Rods ● Positive Full-Pressure Lubrication ● Improved Cooling ● Nickel Chrome Castings ● Dust-Proof Enclosed Crankcase.

QUINCY COMPRESSOR CO.

QUINCY, ILLINOIS

BRANCHES: CHICAGO and NEW YORK

WHERE AIR IS IMPORTANT

QUINCY Compressors

TODAY- WISE SPENDING TO KEEP WORKERS CONTENTED IS GOOD BUSINESS

Invest in practical "industrial relations" that employees appreciate... ScotTissue Towels

AND NOW is the time to invest, when satisfactory working conditions mean so much to your employees.

It pays to provide them with the same washroom conveniences and sanitary conditions they enjoy at home . . . for your own protection, as well as theirs.

Satisfaction and sanitation both depend on a clean, individual towel service . . . and the most economical towels for your washrooms are ScotTissue Towels.

They're soft, pliant and cloth-like, made by a specially patented process, and s-t-r-e-t-c-h to absorb every last bit of moisture. You will find that one ScotTissue Towel usually dries drier than four ordinary paper towels. That's why they are so inexpensive . . . and how your employees will appreciate a sanitary individual towel for every using!

May we send you a sample package for a test in your washrooms? A request on your business letterhead is all that is necessary. Scott Paper Company, Chester, Pennsylvania.

• • •

SCOTTISSUE, the same toilet paper that is preferred in millions of homes, is now available in Service-Roll form to large industrial users, at surprisingly low cost.

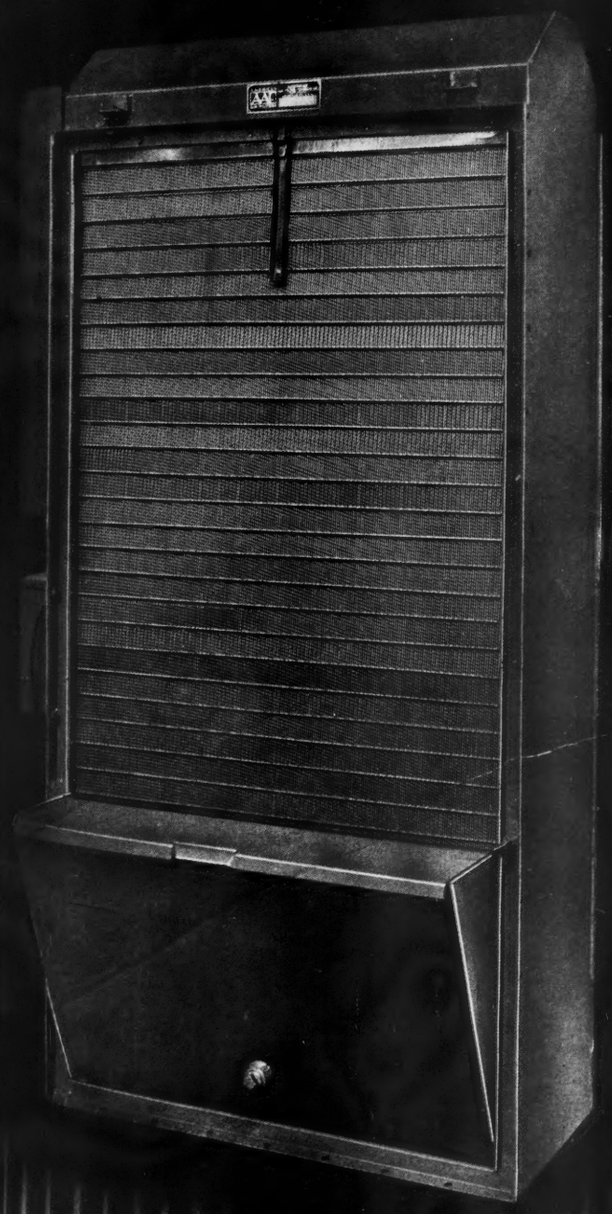
Thirsty Fibre Really DRIES

ScotTissue Towels

BY THE MAKERS OF SCOTTISSUE, WALDORF AND SCOTTOWELS FOR HOMES

Announcing

THE NEW ARMORED Multi-Panel AIR FILTER



Introducing an entirely new and unique panel construction to further improve the already outstanding performance of the *Multi-Panel Air Filter.*

This new **"armored"** panel with its 3 stages of air cleaning maintains the present high efficiency and normal operating resistance of the *Multi-Panel* filter and offers the added advantage of handling excessive lint concentrations or heavy dust loads without clogging.

AMERICAN AIR FILTER CO., INC.
INCORPORATED
269 Central Ave., Louisville, Ky. In Canada: Darling Bros., Ltd., Montreal, P.Q.

The "Utility Factor" of a belt is determined by the number of working hours it efficiently transmits power from the driver to the driven pulley. The span of this "utility factor" is in direct proportion to the permanency of the frictional qualities of the belt.

The high frictional qualities of Monobelt are permanent. They are inherent in the belt and will last through-out its entire life.

Monobelt's high coefficient of friction is not the result of some surface treatment that loses its potency after a short period of use. It is "built" into the belt in successive steps thru an exclusive Alexander Manufacturing process in which the natural tenacious properties of leather are not only retained, but greatly intensified. This results in a prolonged "utility factor."

To get maximum efficiency from your regular drives, to decrease power costs and eliminate useless power waste, to reduce operation expense by obtaining efficient power transmission . . . day after day . . . year after year,

EQUIP YOUR DRIVES WITH MONOBELT.

BUY FROM DISTRIBUTORS FOR ECONOMY

Alexander Brothers
PHILADELPHIA PENNSYLVANIA
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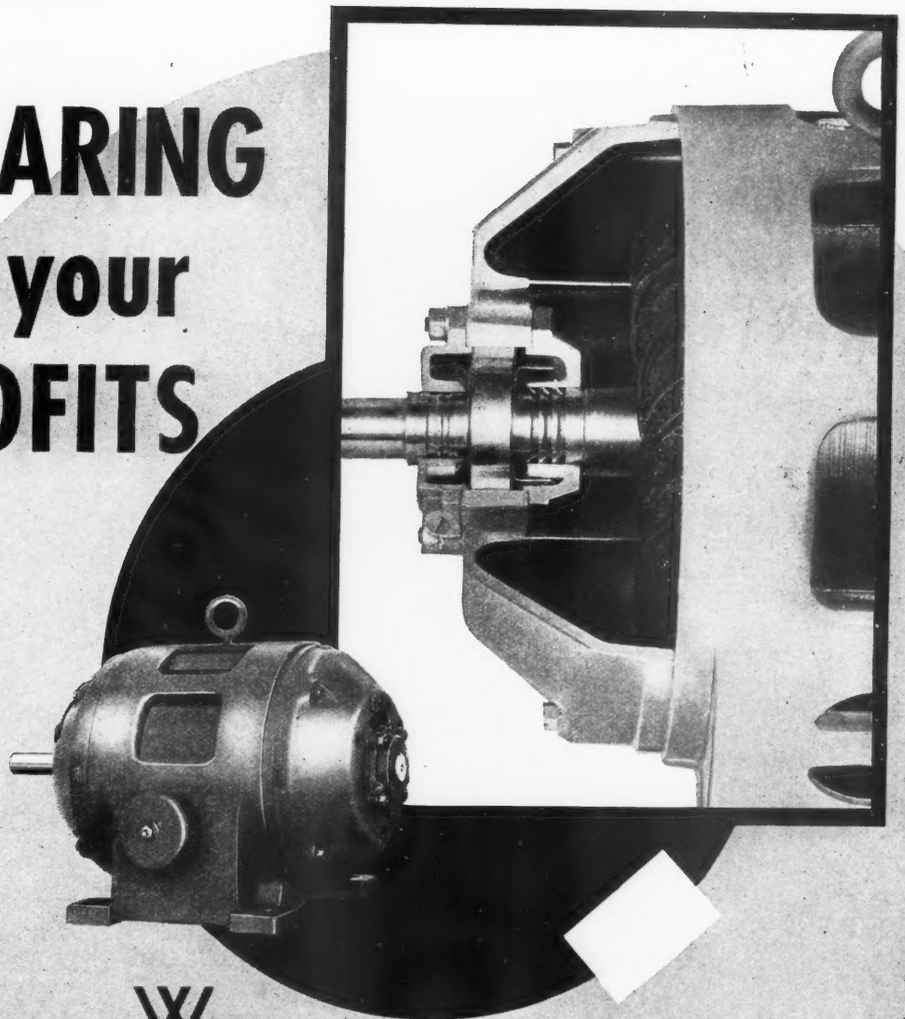
BRANCHES AND DISTRIBUTORS IN PRINCIPAL CITIES

A BEARING on your PROFITS



What happens if grease leaks out of motor bearings? The answer is—it costs you money. Stop a moment and consider: (1) sooner or later you will have to replace the bearings for, if the bearing seal does not retain the grease, it will not keep out dust and grit and there will be bearing wear; and (2) while the motor is shut down for repairs, production will be choked or stopped completely!

But these expenses can be eliminated by installing Crocker-Wheeler ball-bearing motors. The patented, frictionless, bearing seal positively prevents grease leakage and the entrance of foreign matter. The grease itself forms the seal by means of a pumping action similar to that of a centrifugal pump. Many Crocker-Wheeler motors have gone 5, 7 and even 10 years without having the grease changed. Does this sound worth investigating? Write for bulletin 250.

CROCKER-WHEELER
TRADE MARK REG. U.S. PAT. OFF.

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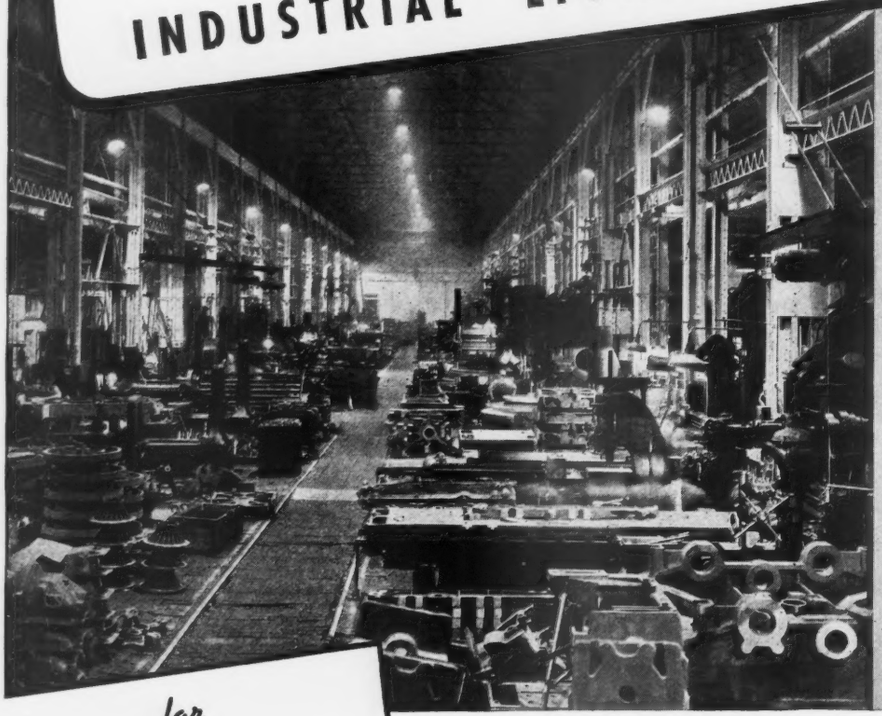
CROCKER-WHEELER ELEC. MFG. CO.
Main Office and Works: AMPERE, N. J.
SALES OFFICES IN PRINCIPAL CITIES

YOU'LL GET MORE FOR YOUR MONEY *with Westinghouse* INDUSTRIAL LIGHTING EQUIPMENT



Westinghouse High Intensity Mercury Diffuser Units are especially suitable for the lower mounting heights.

Westinghouse 400-watt High Intensity Mercury Aluminum Reflectors provide plenty of evenly distributed illumination on the working plane in this machine shop.

WHERE CLOSE-SEEING IS ESSENTIAL SPECIFY HIGH INTENSITY MERCURY

High Intensity Mercury Lighting offers unusual benefits within a wide range of applications. It eliminates eye fatigue, speeds up seeing, reduces accidents, increases accuracy. Its penetrating quality is especially suited to the manufacture of objects with smooth bright surfaces, such as automobile bodies, machine parts and small appliances. Providing 2 to 3 times as much illumination as ordinary light sources, flaws and defects can be quickly identified in "work-in process." Precision operations are greatly facilitated. Dangerous hazards are substantially eliminated. Practical operating economies are realized.

Where the effect of actual daylight is desired for color discrimination, a combination of Mercury and Incandescent Lighting may be utilized with excellent results.

Westinghouse alone makes a complete line of High Intensity Mercury Lighting Equipment, including reflectors, ballast equipment, lamps and accessories. For full details, consult your local Westinghouse Jobber Lighting Specialist; or write direct to Westinghouse Electric & Mfg. Co., Lighting Division, Edgewater Park, Cleveland, Ohio.

for HEAVY INDUSTRIES *Specify* Millite

Critical factor in all lighting equipment for the heavy service industries is *how to maintain reflecting surfaces!* Ordinary glass-covered units present dangerous breakage hazards. Millite solves this problem with a special cover glass capable of resisting extraordinary heat and impact. Applications include Steel Mills, Foundries, Forge Shops, Cement and Chemical Plants, etc. Ask your local Westinghouse Jobber Lighting Specialist for new descriptive folder.

WHEN YOU THINK OF *Lighting* THINK OF

Westinghouse

THE MAINTENANCE CREW WALKS BY...!

AFTER YOU BUILD WITH *TRANSITE*–

HERE'S a shadow that rarely stops on buildings whose roofs and sides are protected by J-M Corrugated Transite.

For the protection is permanent . . . and virtually maintenance-free. By the very nature of its asbestos-cement composition, Transite is fireproof, impervious to weather and rot, highly resistant to corrosion. And it never needs painting.

Far from being mere claims, these statements sum up Corrugated Transite's record of long service, earned under the most rigorous industrial conditions. A record of permanent protection that can be duplicated on your buildings, too.

Corrugated Transite goes on the roof or sides of any skeleton-frame structure as easily as wood or metal. Brochure TR-12A gives complete details. Write Johns-Manville, 22 E. 40th St., N.Y.C.

JM Johns-Manville

TRANSITE

Flat or Corrugated

The moment you install

This Famous

TRICO
REG. U. S. PAT. OFF.

Combination

You

Stop Wasted Kilowatts and Wasteful Shutdowns

Today, in modern plants, "*ordinary*" fuses and unprotected fuse clips are passé. Modern trends demand equipment that is SAFE, EFFICIENT, AND DEPENDABLE. It's the only answer to lower production costs.

TRICO FUSES

have a ***different*** renewal element. It's self-contained — powder-packed — non-interchangeable with "bare links" and therefore, positively tamper-proof.

Powder-packing RE-INFORCES the fusible link—it cannot sag, stretch, lose its rated capacity or become damaged in handling.

All blowing action is confined to the inner casing —cleaning and scraping is eliminated and outer parts are protected from destruction.

Write for Bulletin 206-Y. It tells why leading engineers everywhere are switching to ***Powder-packed*** renewable fuses.

LOOK ON THE INSIDE—

That powder-packed element is worth a million dollars — yet COSTS NO MORE!

KLIPLOK CLAMPS

POOR CONTACT between fuses and clips causes destructive temperatures—premature fuse blowings—damaged clips—charred fuse casings—wasted Kilowatts—idle machinery and workmen.

KLIPLOK CLAMPS eliminate these losses by **forcing** the needed pressure.

Made in various sizes to fit all types and styles of clips. **USE KLIPLOKS EVERYWHERE !**

Fully covered by U. S. Patents

TRY TRICO TODAY!

From every Angle

HIS CATALOG REFLECTS THE INFORMATION YOU NEED

Looked at from the angle of a catalog for industry the Crane No. 52 Catalog lists, describes, illustrates and prices more than 38,000 separate valve and fitting items covering practically every normal requirement of modern industry.

Looked at from the angle of the engineer this same book contains valuable information on all piping and control problems.

Looked at as a source of reference data you will find almost 100 solid pages of formulas, tables and engineering material.

Looked at from any angle, when you are using the Crane No. 52 Catalog, you are using the largest, most complete encyclopedia of valves, fittings and piping equipment in the world. The ease with which Crane can meet your requirements assures you just the right equipment you need for every service. CranEquip your plant throughout for maximum satisfaction.

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO, ILLINOIS

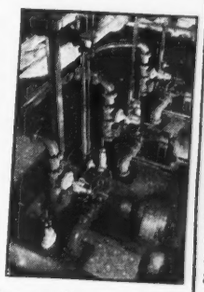
Branches and Sales Offices in One Hundred and Sixty Cities

VALVES, FITTINGS, FABRICATED PIPE, PUMPS, PLUMBING AND HEATING MATERIAL

---

plied in the next few days.

TOPS FROM THE POWER ANGLE



CHICAGO, ILL., Oct. 21—No man on earth can get more good out of a Crane No. 52 Catalog than an engineer in charge of a power plant. From Page 1 to Page 764, your Crane catalog is packed with information about items, most of which are used in service lines of one kind or another. Then, too, the engineering data in the big orange colored book is just what is needed for the day-to-day problems of the men responsible for piping systems.

Go over the Index of your Crane No. 52 Catalog carefully now. There are nine sheets in the Index, closely printed on both sides. An astonishing variety of piping supplies are covered on these pages. They are so carefully indexed that you can find the valve or fitting you want by starting with the type, the metals used, or the service for which you want a particular article.

CranEquipping makes even a good plant better. Use your Crane No. 52 Catalog to pipe your plant for lasting satisfaction. Or, if you have that rare instance—a problem not easily solved by regular CranEquipment, consult us about our special designing service.

take the TEETH out of air

Coppus Air Filters improve working conditions, cut cleaning costs, protect product purity . . . they are designed to give you the efficiency you need.

A piece of dust is your tiniest enemy, and one of the most dangerous. The smaller — the more treacherous . . . for the microscopic particles are highly abrasive and hard to catch. Particles as small as 2 microns pass most filters.

Coppus Air Filters are engineered to meet your requirements up to 95.6% efficiency against 2 micron-size particles. This is the highest rating of all commercial filters.

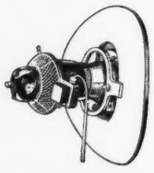
There's virtually no maintenance. No oil coated medium. No wires to break. A minimum of welds.

Such firms as Beechnut Packing, Standard Brands, Columbia Broadcasting, Celluloid Corp., American Can, General Ice Cream, Bibb Manufacturing, Morton Salt, Arcadia Knitting Mills, etc. — use Coppus Air Filters for such jobs as

removal of throat-irritating dust
saving on cost of cleaning equipment
protection of product purity
cleaning air for process work
recovery of valuable substances from air
preventing dust explosions
preventing dust-caused contamination

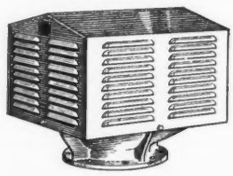
Write Coppus Engineering Corp., 375 Park Ave., Worcester, Mass., for bulletins. Branches and representatives in principal cities — see listing in THOMAS' REGISTER. In SWEET'S—Air Filters for Engines and Compressors, Mine Ventilation Equipment, Forced Draft Blowers, Steam Turbines.

In manholes or in *any* confined working space: tunnels, pipe galleries, coal pockets, process tanks, storage bins, etc., the *Cable Manhole Ventilators* (Bulletin 163).

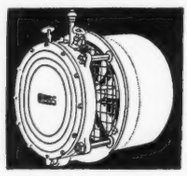


For rapid cooling and ventilating of boilers, tanks retorts, etc., the *Boiler Manhole Blower* (Bulletin-161-3).

For directing a flow of cool-air upon workmen (also cooling off furnaces, ventilating motors, generators, etc.,) the *Heat Killer* (Bulletin 160-4).



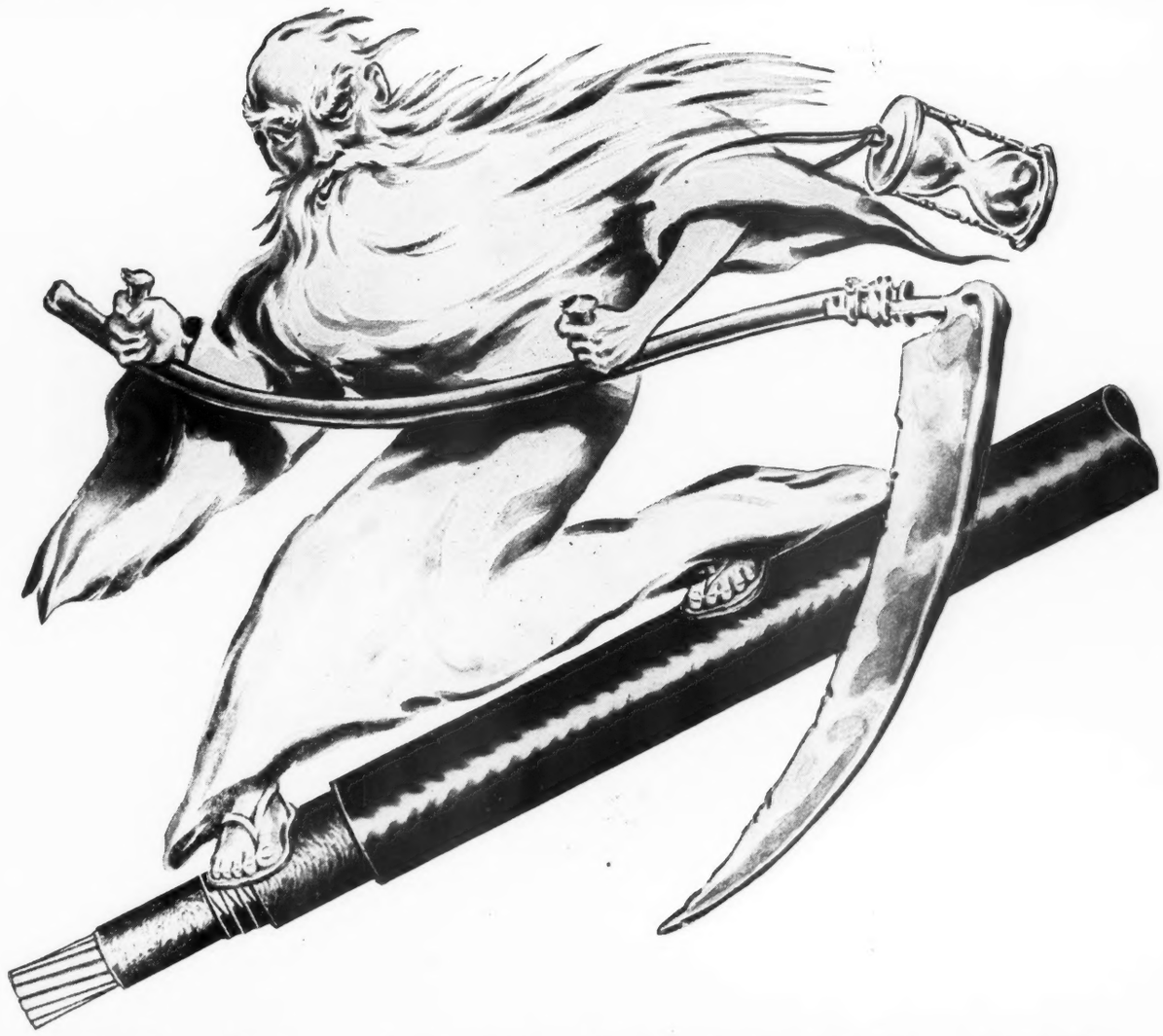
Attached to the intake of air compressors and engines, the Coppus Air Filter provides clean air, free from abrasive dust particles (Bulletin F-310-3).



To increase boiler capacity or to improve draft conditions, the *Forced Draft Blower* (Bulletin 145-5).

FRESH AIR FOR MEN AND MACHINES COPPUS

COPPUS AIR FILTERS PASS CLEAN AIR



OLD POP TIME

Time . . . just plain, ordinary, everyday *time* . . . can ruin almost anything. That's why you can't blame the old boy for swinging away at our cable. He has an idea that all wire insulation is alike because he recalls putting a lot of it on the skids in pretty short order. But, he forgets that Rockbestos is made of *asbestos,* a mineral almost as old as time, which has resisted deterioration for millions upon millions of years.

That's why we say Rockbestos has time licked. Its insulation doesn't dry out, crack, or flake with age. It stands up under heat like a Fiji Islander. You can't make it burn even if you use a blow torch. And its high resistance to oil, grease, corrosive fumes and moisture is built in with laboratory developed impregnating compounds and exclusive processing methods.

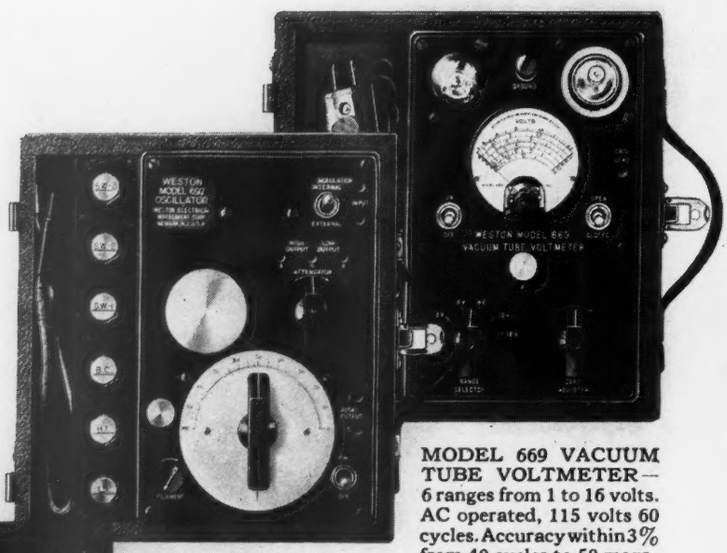
Our entire line of heat resisting wires, cables and cords is illustrated in our No. 10-D catalog. We'll send one if you would like to know more about them, and samples too, if you give us an idea of the wires you are interested in. Just drop a line to Rockbestos Products Corporation, 866 Nicoll Street, New Haven, Conn.

Also refer to Electrical World Buyer's Reference Number of Dec. 19, 1936. Part II.

ROCKBESTOS A.V.C.—*the wire with permanent insulation*

FOR PRODUCTION OR MAINTENANCE TESTING

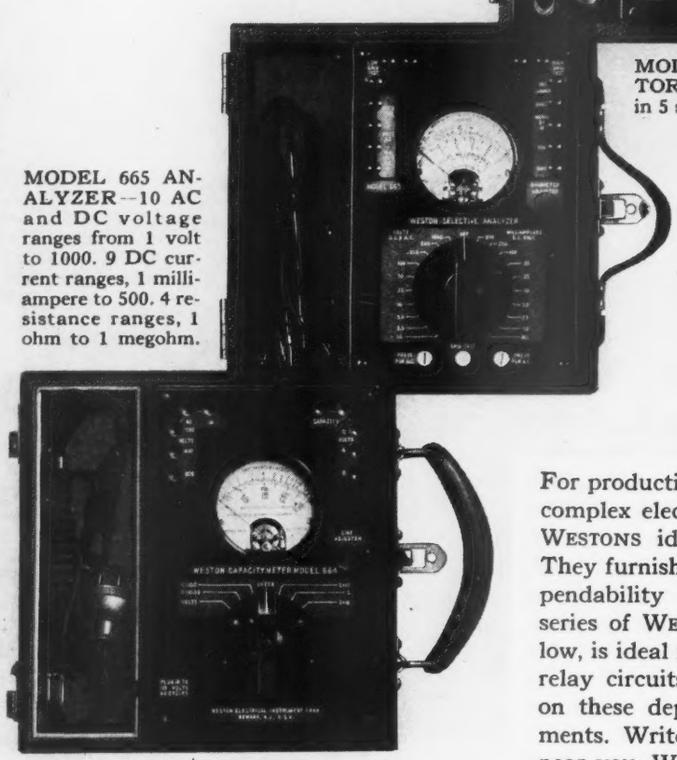
choose dependable instruments



MODEL 669 VACUUM TUBE VOLTMETER—6 ranges from 1 to 16 volts. AC operated, 115 volts 60 cycles. Accuracy within 3% from 40 cycles to 50 megacycles.

MODEL 692 OSCILLATOR—100 KC—22 MC in 5 separate bands.

MODEL 665 ANALYZER—10 AC and DC voltage ranges from 1 volt to 1000. 9 DC current ranges, 1 milliampere to 500. 4 resistance ranges, 1 ohm to 1 megohm.



MODEL 664 CAPACITY METER—5 ranges in microfarads from .0001 to 200. AC voltage ranges 0-800.

FROM THE *Complete* WESTON LINE

For production testing of simple electrical elements . . . or complex electrical circuits . . . you'll find these portable WESTONS ideal for thorough, time-saving test routine. They furnish the ranges, operating simplicity, and the dependability needed at each inspection point. And the series of WESTON pocket-size instruments illustrated below, is ideal for quick trouble shooting on control circuits, relay circuits, cables, etc. You will want complete data on these dependable, inexpensive WESTON Test Instruments. Write to Newark, or 'phone the WESTON office near you. Weston Electrical Instrument Corporation, 628 Frelinghuysen Avenue, Newark, New Jersey.

MODEL 695 POWER LEVEL METER—5 voltage ranges 0-150. 11 DB ranges —18DB +38 DB.

MODEL 697 VOLT-OHM-MILLI-AMMETER—4 AC—DC voltage ranges. 2 DC current ranges. 2 resistance ranges.

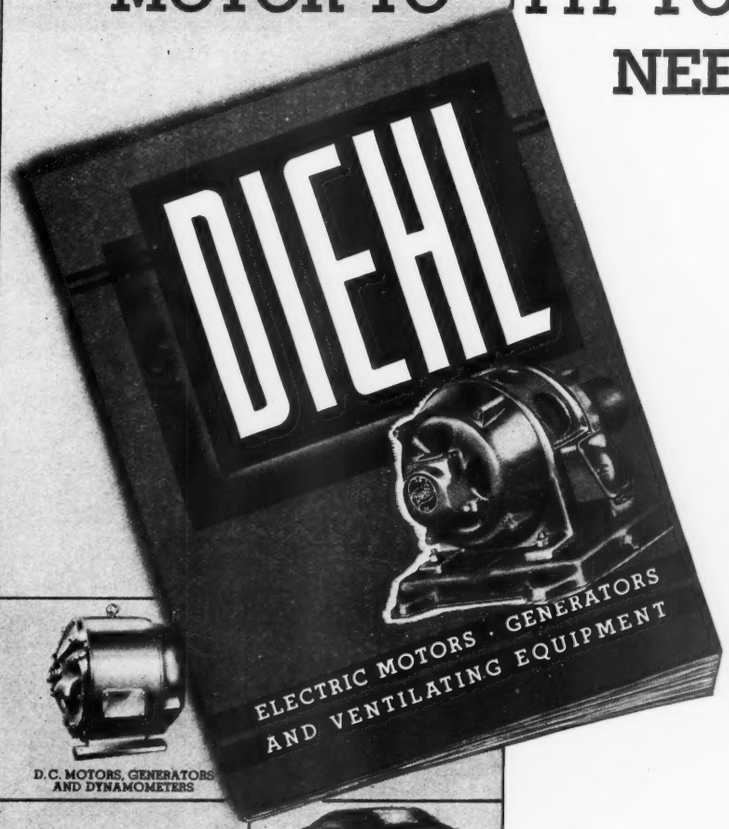
MODEL 564 VOLT-OHM-METER—4 DC voltage ranges 3-600. 4 resistance ranges 1000 ohms to 1 megohm.

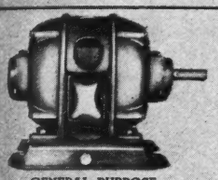
MODEL 780 CAPACITY METER—Range full scale .02—.2—2—20 microfarads. AC operated.

SELECT THE EXACT MOTOR TO FIT YOUR NEEDS

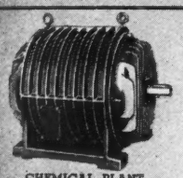
TYPICAL DIEHL APPLICATIONS

ADDING MACHINES
AIR CONDITIONING MACHINERY
AGITATORS
BAKERS' MACHINERY
BALANCING MACHINES
BATTERY CHARGING SETS
BLOWERS
BOTTLING MACHINERY
CALCULATING MACHINES
CAMERAS & PROJECTING EQUIP'T
CANDY MAKING MACHINES
CANNING MACHINERY
CEMENT MAKING MACHINERY
CHEMICAL PLANT MACHINERY
CHURNS
CIGARETTE MAKING MACHINES
CIRCULATORS, AIR
CLAY MAKING MACHINES
COAL MACHINERY
COKE MACHINERY
COFFEE MACHINERY
COMPRESSORS
CONVEYORS
CRANES
DAIRY APPARATUS
DENTAL MACHINES
DISHWASHERS
DRIERS
ELECTRO-PLATING EQUIPMENT
ELEVATORS
ESCALATORS
FANS, EXHAUST
FIRE ALARM SYSTEMS
FLOUR MILL MACHINERY
FOOD PROCESSING MACHINERY
GENERATING EQUIPMENT
GLASS MAKING MACHINERY
GRINDING MACHINERY
HOISTS
HYDRAULIC MACHINERY
LAUNDRY MACHINERY
LOOMS, TEXTILE
MACHINE TOOLS
DRILL PRESSES
PUNCH PRESSES

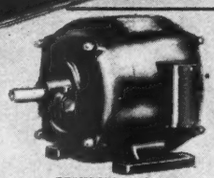


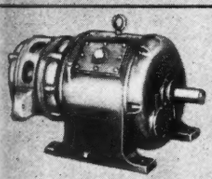

GENERAL PURPOSE SQUIRREL CAGE MOTORS

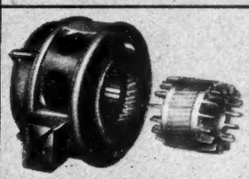
D.C. MOTORS, GENERATORS AND DYNAMOMETERS

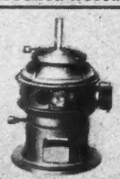

CHEMICAL PLANT MOTORS

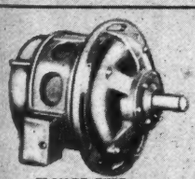
A.C./D.C. UNIVERSAL MOTORS


REPULSION START INDUCTION MOTORS


GEAR MOTORS

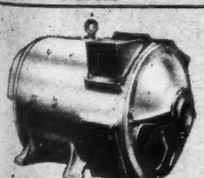

SHAFTLESS MOTORS

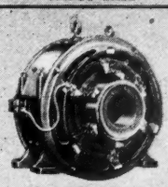

VERTICAL MOTORS—RING BASE


FLANGE TYPE MOTORS

VERTICAL MOTORS TRIPOD BASE

SLIP RING MOTORS


DIRECT CURRENT MARINE MOTORS AND GENERATORS


D. C. ENGINE TYPE GENERATORS

SPLIT PHASE FRACTIONAL HORSEPOWER MOTORS

Plant and product modernization demand the utmost in motor drive efficiency, economy and dependability. There is only one RIGHT motor to meet the requirements of each application.

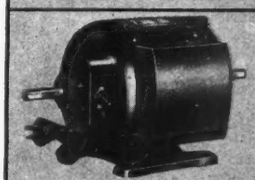
The diversified Diehl line offers many types and sizes from which to select the exact motor to fit your needs. Standard motors are obtainable from stock for usual requirements. Special designs for exceptional conditions can be developed in a minimum of time. All are products of the same facilities and abilities which have enabled Diehl to design and produce motors that have satisfactorily met the requirements of exacting manufacturers in all branches of industry for half a century.

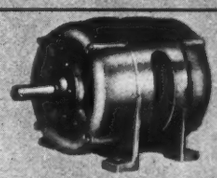
Tell us your requirements and our engineering staff will gladly recommend the proper motor equipment to meet your needs.

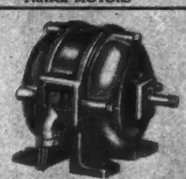
To all who use or choose motors the Diehl Catalog No. 1881 illustrated above will prove very helpful. Write for a copy.

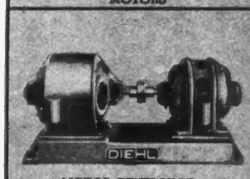
TYPICAL DIEHL APPLICATIONS

MACHINE TOOLS CONT'D
SHAPERS
GRINDERS
BORING MILLS
PLANERS
LATHES
SHEARS
BLANKING PRESSES
ETC.
METAL WORKING MACHINERY
MINING MACHINERY
MIXERS
MOTOR-GENERATOR SETS
OFFICE APPLIANCES
OIL BURNERS
OVENS
PAINT MAKING MACHINERY
PAPER MAKING MACHINERY
PETROLEUM PRODUCTS MACH'Y
POLISHING MACHINERY
POWER PLANT MACHINERY
POWER TABLES
PRINTING MACHINERY
PULVERIZERS
PUMPS
RECORDING INSTRUMENTS
REFRIGERATING MACHINERY
SCALES
SEPARATORS
SEWING MACHINES
SHOE MAKING MACHINERY
SMELT'G & REFIN'G MACH'Y
SOAP MAKING MACHINERY
STOKERS, MECHANICAL
STONE WORKING MACHINERY
SUGAR REFINING MACHINERY
TABULATING MACHINES
TESTING MACHINES
TEXTILE MACHINERY
TYPEWRITERS
UNIT HEATERS
VACUUM CLEANERS
VENTILATING EQUIPMENT
WASHING MACHINERY
WINCHES
WOODWORKING MACHINERY

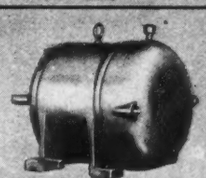

CAPACITOR MOTORS


TEXTILE SPINNING FRAME MOTORS


TEXTILE LOOM MOTORS



MOTOR-GENERATOR SETS

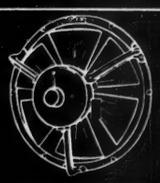

TOTALLY ENCLOSED FAN-COOLED MOTORS

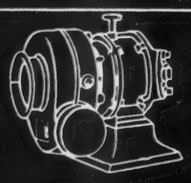
DIEHL MANUFACTURING CO., Elizabethport, N. J.
Pioneer Manufacturers of Motors, Generators and Fans
Electrical Division of THE SINGER MANUFACTURING CO.
ATLANTA BOSTON CHICAGO DALLAS NEW YORK PHILADELPHIA

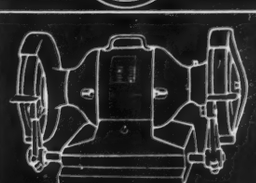
Diehl

DIEHL DESK AND BRACKET FANS

DIEHL AIR CIRCULATORS


DIEHL EXHAUST AND VENTILATING FANS


DIEHL PORTABLE VENTILATING SETS

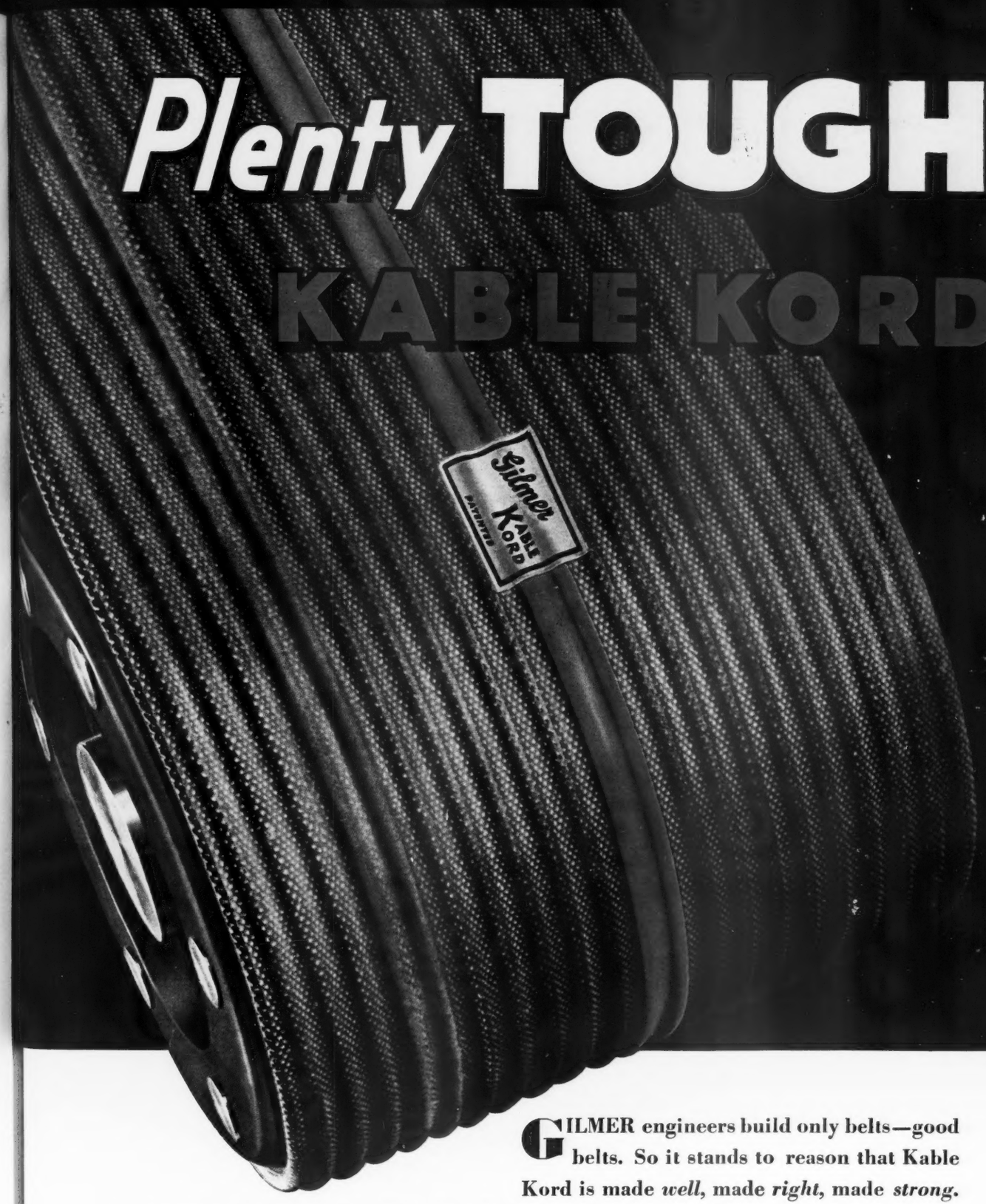

DIEHL ELECTRIC GRINDERS

HAVE YOU INCLUDED WATER COOLING IN YOUR 1938 BUDGET ?

● Frigidaire Water Cooling Equipment is one of the soundest investments you can make in 1938. It pays dividends in comfort and health for your men . . . in goodwill, greater efficiency, more production, fewer accidents. Investigate at once. Include Frigidaire equipment in your 1938 budget. A complete analysis of your water cooling requirements will be made without cost. For this free survey and estimate, see your nearest Frigidaire Commercial dealer or write Frigidaire Division, General Motors Sales Corporation, Dayton, Ohio.

Plenty TOUGH

KABLE KORD



GILMER engineers build only belts—good belts. So it stands to reason that Kable Kord is made *well*, made *right*, made *strong*. No other flat belt's like it—there's just one Kable Kord. It's a husky brute with a heavy hide that takes punishment and wears. Fact is, Kable Kord is a contactor belt *and* a power belt. Contactor cords force the pulling cords to hug flat pulleys with a no-slip grip that delivers maximum power per square-inch. Two-belts-in-one to do your jobs . . . Kable Kord boosts production and cuts down costs.

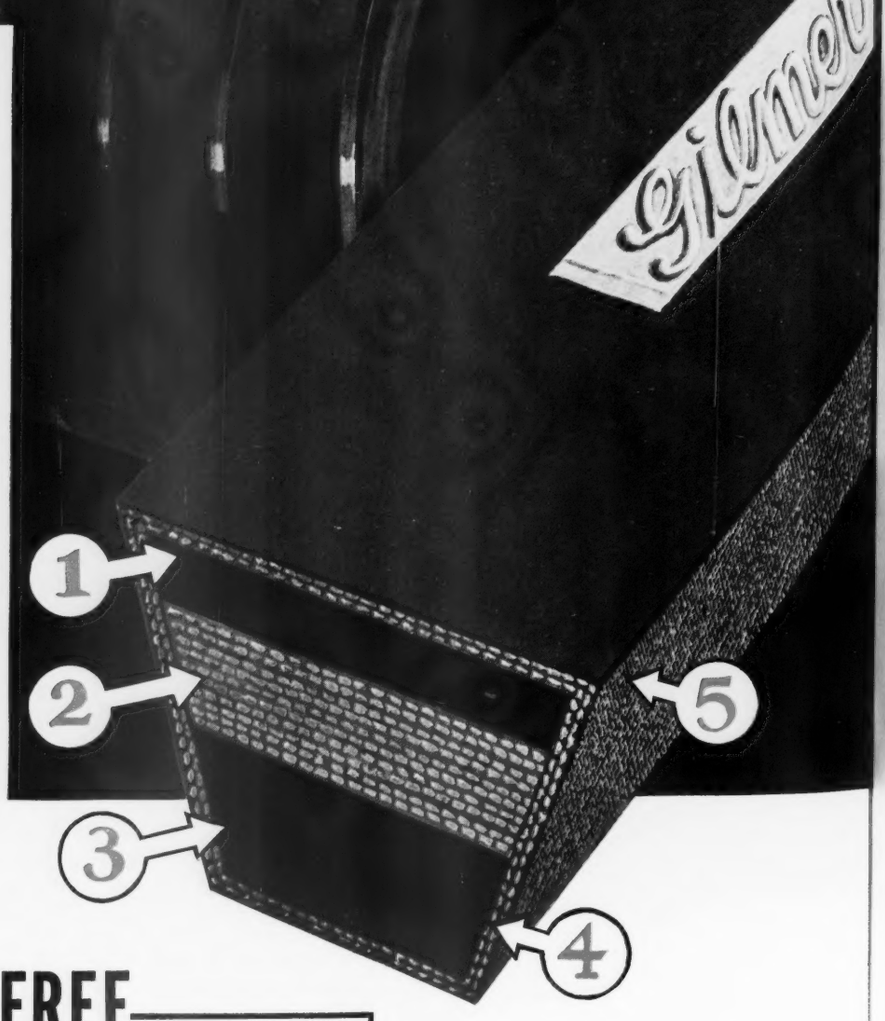
FREE Kable Cord Data Book. Money-saving facts about Kable Kord, endless or in rolls. Send for your copy today.

Gilmer BELTS

L. H. GILMER COMPANY, Tacony, Philadelphia

"THE OLDEST FIRM OF RUBBER FABRIC BELT SPECIALISTS"

5 reasons why Gilmer V-BELT GRIP GIVES POWER



1 TOP RUBBER—Tough, resilient tension rubber. A Gilmer flexes instantly to a perfect seat in the groove. Every Gilmer V-Belt is "tailor-made in the groove."

2 PULLING CORDS—Rubber-locked plies that concentrate great strength and power in a thin pulling section. Patented construction (only Gilmers have it) keeps these plies horizontal in multiple-drive operation.

3 BOTTOM RUBBER—Heat-resisting composition developed by Gilmer engineers. Supports pulling cords in permanent horizontal plane. Gives maximum crosswise rigidity. A Gilmer V-Belt never "squashes."

4 DOUBLE JACKET—Made of twin layers of bias-woven fabric with flexible rubber between. Triples the life of a V-belt; prevents worn spots at any one point; guards all working parts.

5 CONTROLLED STRETCH—Gilmer engineers *pre-test* every Gilmer V-Belt for stretch under full load. Insures permanent matched working lengths on multiple drives. Prevents "under-belting," unmatched loads. Stops power waste.

FREE

Gilmer V-Belt Catalogue. Your copy's ready.

Gilmer Single Strand V-Belts for fractional horsepower drives have the same *Gilmer Grip.*

L. H. GILMER COMPANY, Tacony, Philadelphia

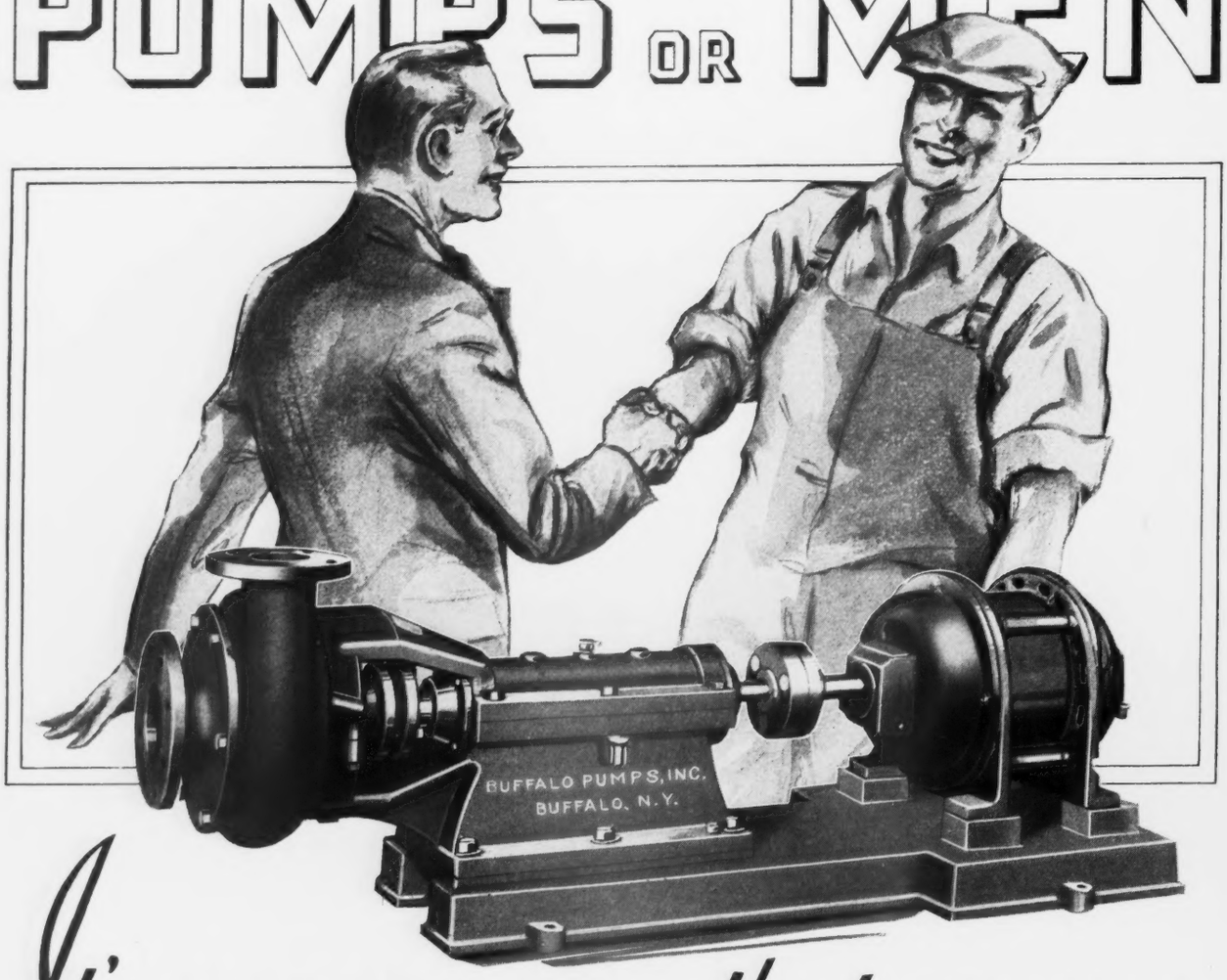
"THE OLDEST FIRM OF RUBBER FABRIC BELT SPECIALISTS"

Switching mechanism is isolated from interference with connecting wires, with make and break confined in a porcelain well, separated from opposite polarity and with no exposed mechanism. Parallel jaws evenly distribute the arc which is broken on a sector of a circle:—no single-point break to cause pitting. Double break in each leg sharply reduces the arc; prolongs life of contacts. Break overload is cut to minimum by the parallel-radius break and quick operating mechanism. Full floating, self-aligning contacts provide automatic adjustment for movable and stationary contacts. Rotor contacts project beyond barrier surface, which moves between stationary contacts without rubbing. Heavy spring tension on stationary contacts makes positive connections. Fibre barrier is treated to resist moisture; cannot swell or warp out of shape or alignment. Top-wired for convenient installation; all connections easily accessible in roomy box, with handy knockouts in variety of sizes. Finished in attractive gray enamel. For *complete-line* listings of these Type D Switches, ask for new Safety Starting Switch Catalog No. 7...

THE ARROW-HART & HEGEMAN ELECTRIC CO.

HARTFORD. CONNECTICUT, U. S. A.

PUMPS OR MEN



It's PERFORMANCE that COUNTS

How many times have you said to yourself, "I wish I had more men like Jim. He gets things done on time. He does them right. He knows how to work efficiently. He's a good profit maker for us. He's winning promotion fast, because he *deserves* it."

If "Buffalo" Pumps were men, they would be quickly placed in the same class with Jim. They, too, have a long record of outstanding performance in all types of industry that has won them high praise, and many repeat orders for more "Buffalo" Pumps.

If you want the pumping jobs in your plant to be done more efficiently, more economically year in, year out—then it will pay you to get the facts on "Buffalo" Pumps. Write for them today.

BUFFALO PUMPS, Inc., 471 Broadway, Buffalo, N. Y.

Branch Engineering Offices in Principal Cities **In Canada: Canada Pumps, Ltd., Kitchener, Ont.**

"Buffalo" PUMPS

used where Performance Counts

Specify

"A.W." ROLLED STEEL FLOOR PLATE *for Safety!*

"A. W." SUPER DIAMOND PATTERN—HALF SIZE

"A. W." STANDARD DIAMOND PATTERN—HALF SIZE

"A. W." DIAMONDETTE PATTERN—HALF SIZE

Engineered primarily for safety, "A.W." Rolled Steel Floor Plate offers so many advantages of such importance in new construction work that, for more than a third of a century, it has been the consistent preference of managements and engineers in industry.

- Its low first cost is also its last cost—there is no maintenance problem nor expense
- Designed to cover an entire floor or to reinforce especially vulnerable areas, as well as for traffic aisles, stair treads, runways, catwalks, etc.
- Installation is PERMANENT—and results in an absolutely sanitary flooring which drains rapidly, is easily cleaned, and is heat proof, crack proof, oil proof and slip proof
- It bears the hardest, toughest traffic without damage
- "A. W." Floor Plate is in truth the modern flooring for the modern factory and power plant.

"A.W." Floor Plate is offered in five patterns to meet every possible flooring problem. Write for descriptive literature giving complete engineering data.

ALAN WOOD STEEL CO.

ALAN WOOD STEEL CO. ESTABLISHED A.W. TRADE MARK 1826 CONSHOHOCKEN, PA.

CONSHOHOCKEN, PA.

Branches: Philadelphia, New York, Boston, Detroit, Los Angeles, San Francisco, Seattle, Houston

111 YEARS' IRON AND STEEL MAKING EXPERIENCE

Every
INDUSTRIAL EXECUTIVE
can profit by reading this **NEW BOOK**

16 PAGES
IT'S FREE
45 ILLUSTRATIONS

The world's largest, international engineering fair. 5,000 machines in operation; 2,500 exhibitors; machinery, equipment, tools and processes for every industry; 17 gigantic halls; acres of outdoor displays. Simultaneously, the General Merchandise Fairs. A total of 8,500 exhibitors from 25 countries; 250,000 buyers from 72 countries. *Your firm will find new profits*—whether you exhibit, buy or merely investigate. We invite you to write—on your letterhead—for the new book (No. 27) which describes and pictures the engineering exhibits. There is no charge or obligation. Leipzig Trade Fair, Inc., 10 East 40th St., New York.

THE GREAT ENGINEERING AND BUILDING FAIR
MARCH 6TH TO 14TH
A DIVISION OF THE 700-YEAR-OLD
LEIPZIG TRADE FAIRS

LINCOLN
had a bodyguard

• If President Lincoln had informed himself about his bodyguard, on the fateful night of April 14, 1865, his life might have been saved. For that bodyguard, John F. Parker, as a member of the Metropolitan Police Force, had been punished four times for drunkenness and dereliction in duty. Yet no official bothered to get the facts concerning him when he was trusted with the life of the President. When Booth, the assassin, stole up to Lincoln's box, Parker was absent from his post. He had gone out to get a drink!

"Taking things for granted" is frequently found in the selection of the most vital part of electrical devices—the means of contact. The switch is often chosen without sufficient investigation as to its ability. Service men say contact trouble is a most common cause of complaints.

There is one dependable, durable form of contact which you can safely trust—DURAKOOL* Mercury Switches. Unbreakable, non-explosive, and available in capacities up to 200 amperes, DURAKOOL switches are solving new contact problems every day.

DURAKOOL does not manufacture control instruments—only switches. But any control instrument can be equipped with DURAKOOLS.

Send for a copy of the interesting and informative booklet, "The Mercury Switch of Tomorrow." It's free. DURAKOOL, Inc., 1078 North Main Street, Elkhart, Indiana.

* Trade Mark Registered U. S. Patent Office

DURAKOOL
THE PLUS VALUE MERCURY SWITCH
† DURABILITY † ACCURACY † SAFETY † CAPACITY †

WHY WOOD PILES, PRESSURE-TREATED WITH CREOSOTE, ARE MOST ECONOMICAL FOR BUILDING FOUNDATIONS

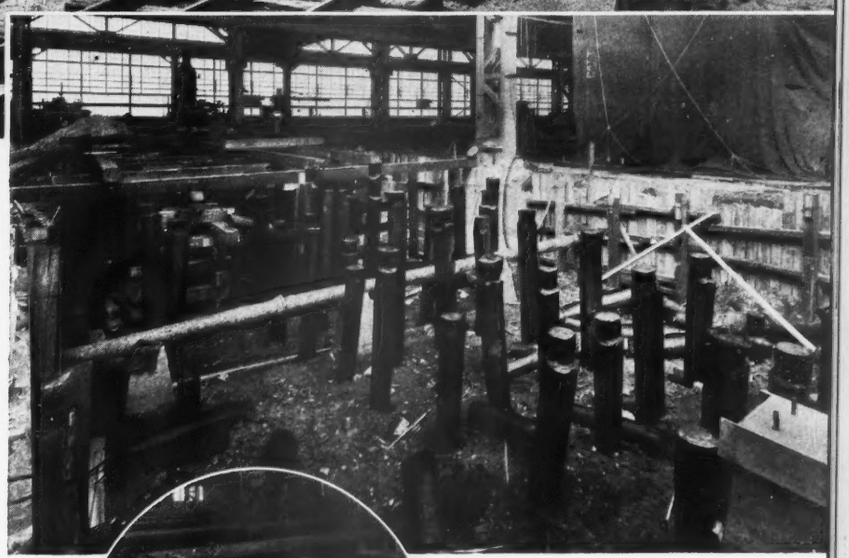
Pressure-treated creosoted piles on one of the plant yards of The Wood Preserving Corporation, a Koppers subsidiary

Pressure-treated creosoted Yellow Pine Piles for building foundations are economical in first cost and durable and dependable. Being lighter than other types of foundations, they are less likely to shift and settle. Pressure treatment with creosote insures durability. Creosoted piles used in many installations over a period of 40 years have proven their permanence.

For the eastern Pennsylvania plant shown in the illustrations on this page, The Wood Preserving Corporation furnished more than a thousand Wood Piles, pressure-treated with creosote, to serve as foundations for heavy machinery. The site is on soft ground along a river bank where rigid and permanent foundations are difficult to maintain.

The Wood Preserving Corporation is in a position to quote on piling for prompt treatment and shipment from its plants located throughout the country.

For information write to Pittsburgh.



Creosoted piles in place, ready for foundation to carry 500-ton press.

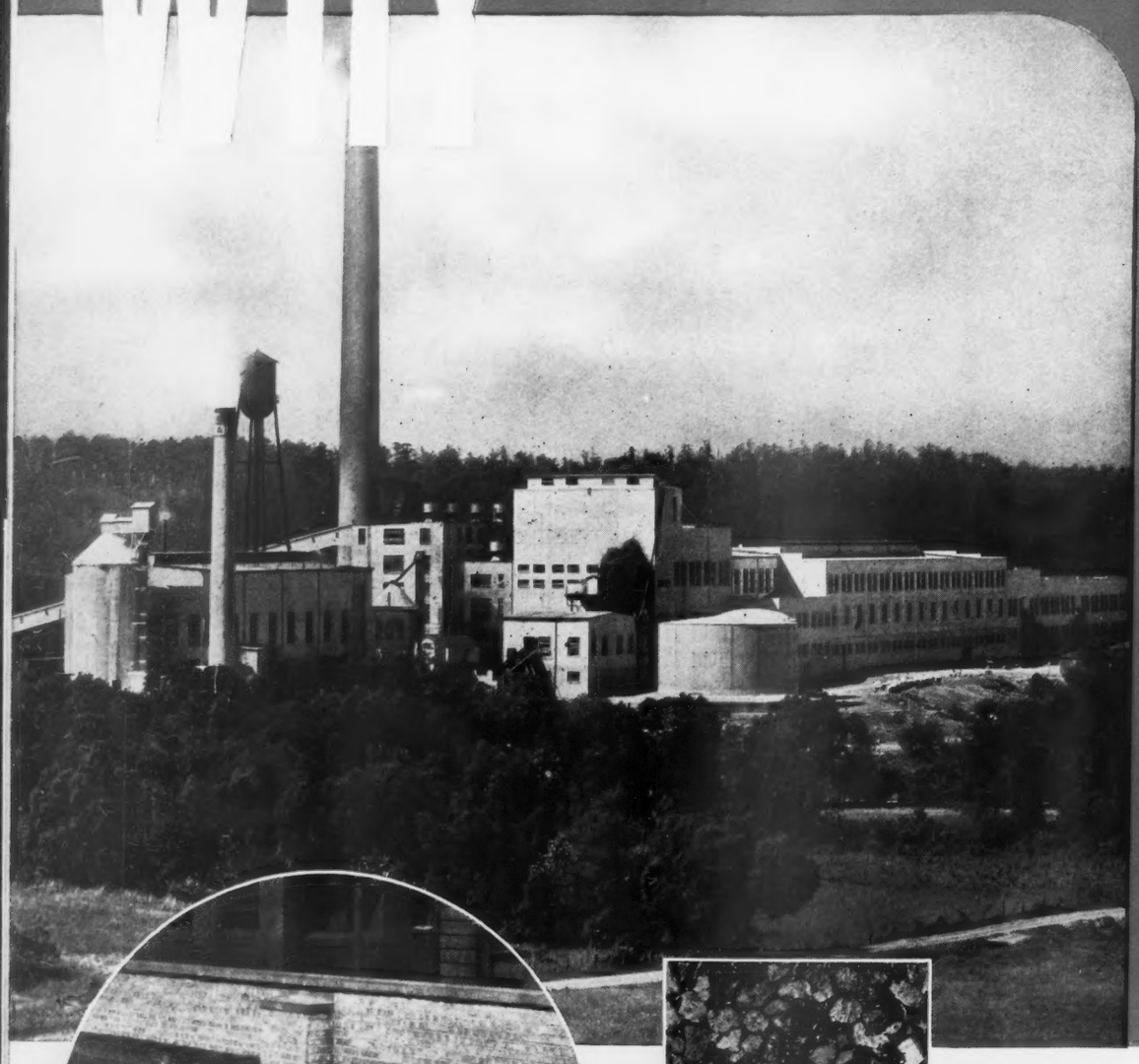
A foundation for one of the milling machines carried on creosoted foundation piling.

A **KOPPERS** SUBSIDIARY

THE WOOD PRESERVING CORPORATION

NATIONAL LUMBER & CREOSOTING COMPANY

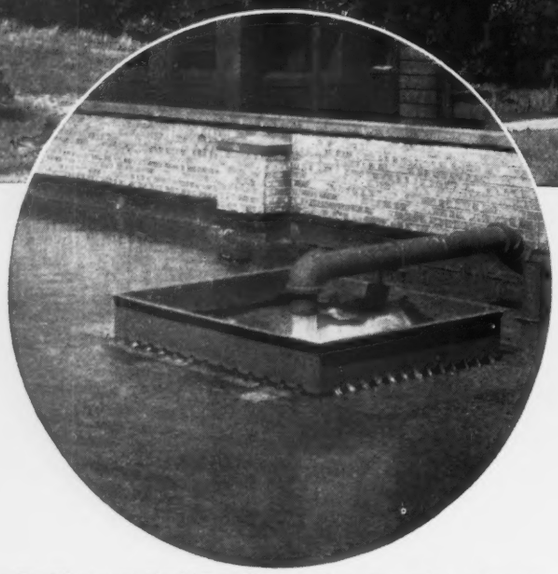
WHY KOPPERS COAL TAR ROOFS Last Longer on Factory Buildings



Koppers Divisions, Subsidiaries and Affiliates Serving the Manufacturing Industries

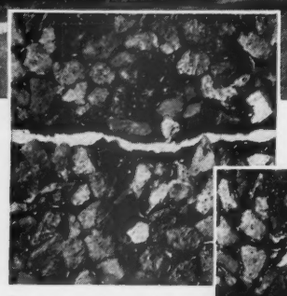
AMERICAN HAMMERED PISTON RING DIVISION — BALTIMORE, MD.
BARTLETT HAYWARD DIVISION — BALTIMORE, MD.
ENGINEERING AND CONSTRUCTION DIVISION — PITTSBURGH, PA.
GAS AND COKE DIVISION — PITTSBURGH, PA.
TAR AND CHEMICAL DIVISION — PITTSBURGH, PA.
WESTERN GAS DIVISION — FORT WAYNE, IND.
EASTERN GAS AND FUEL ASSOCIATES — BOSTON, MASS.
THE KOPPERS COAL COMPANY — PITTSBURGH, PA.
NEW ENGLAND COAL & COKE COMPANY — BOSTON, MASS.
THE WHITE TAR COMPANY OF NEW JERSEY, INC. — KEARNY, N. J.
THE WOOD PRESERVING CORPORATION — PITTSBURGH, PA.
NATIONAL LUMBER & CREOSOTING COMPANY — TEXARKANA, ARK.-Tex.

Let us send you the Koppers Roofing Specification Book which describes these qualities of Koppers Roofs

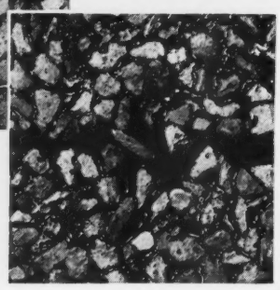


1 Koppers Coal Tar Pitch resists the action of water, even under prolonged exposure.

This property of coal tar pitch is especially important because so many roofs are flat and it is impossible to prevent accumulation of water on the roof. The roof you use must therefore be waterproof. That Koppers Roofs are waterproof is shown by the fact that they are widely used as a cooling bed for water from air-conditioning systems. The coal tar pitch actually *improves* with this treatment.



Koppers Roofing panel broken for test.



Same panel, with break healed at normal summer-time roof temperatures.

2 Koppers Roofs have the property of self-healing.

Weathering and rapid changes in atmospheric conditions can cause cracks in the top surfaces of some types of roofing. If your roof is a Koppers Coal Tar Pitch Roof these small breaks will heal themselves.

Koppers Principal Products for the Manufacturing Industries

Koppers Roofing . . . Waterproofing . . . Dampproofing . . . Bituminous Paints . . . American Hammered Piston Rings . . . Fast's Self-aligning Couplings . . . Platework . . . Tanks . . . Cast Iron and Steel Pipe . . . Gas, Air, Water, Tar Valves . . . D-H-S Bronze Castings . . . Iron Castings . . . Western Fire Hydrants . . . Locomotive Packing . . . Creosote Oil . . . Treated Timber, Lumber and Piles . . . Materials-Handling Equipment . . . Tarmac Paving Materials . . . Coal . . . Coke . . . Gas . . . Disinfectants . . . Insecticides . . . Deodorants . . . Pipe . . . Weed Killers . . . Tar Acids . . . Light Oils . . . Naphthalene

KOPPERS COMPANY TAR AND CHEMICAL DIVISION • PITTSBURGH • PA •

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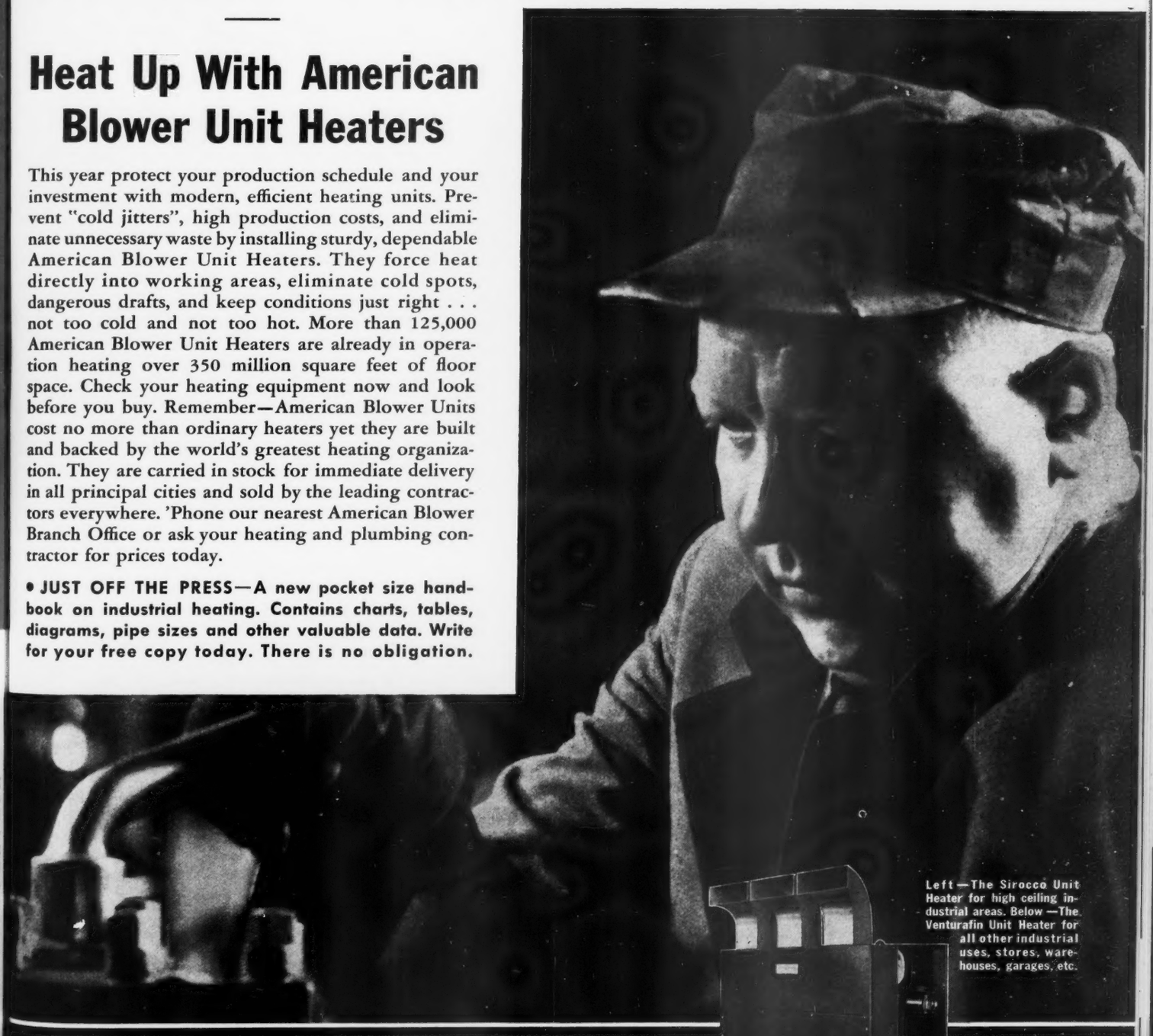
DESIGNERS · BUILDERS · PRODUCERS · MANUFACTURERS · DISTRIBUTORS · OPERATORS

Don't let "COLD JITTERS" STOP PRODUCTION!

Heat Up With American Blower Unit Heaters

This year protect your production schedule and your investment with modern, efficient heating units. Prevent "cold jitters", high production costs, and eliminate unnecessary waste by installing sturdy, dependable American Blower Unit Heaters. They force heat directly into working areas, eliminate cold spots, dangerous drafts, and keep conditions just right . . . not too cold and not too hot. More than 125,000 American Blower Unit Heaters are already in operation heating over 350 million square feet of floor space. Check your heating equipment now and look before you buy. Remember—American Blower Units cost no more than ordinary heaters yet they are built and backed by the world's greatest heating organization. They are carried in stock for immediate delivery in all principal cities and sold by the leading contractors everywhere. 'Phone our nearest American Blower Branch Office or ask your heating and plumbing contractor for prices today.

• JUST OFF THE PRESS—A new pocket size handbook on industrial heating. Contains charts, tables, diagrams, pipe sizes and other valuable data. Write for your free copy today. There is no obligation.

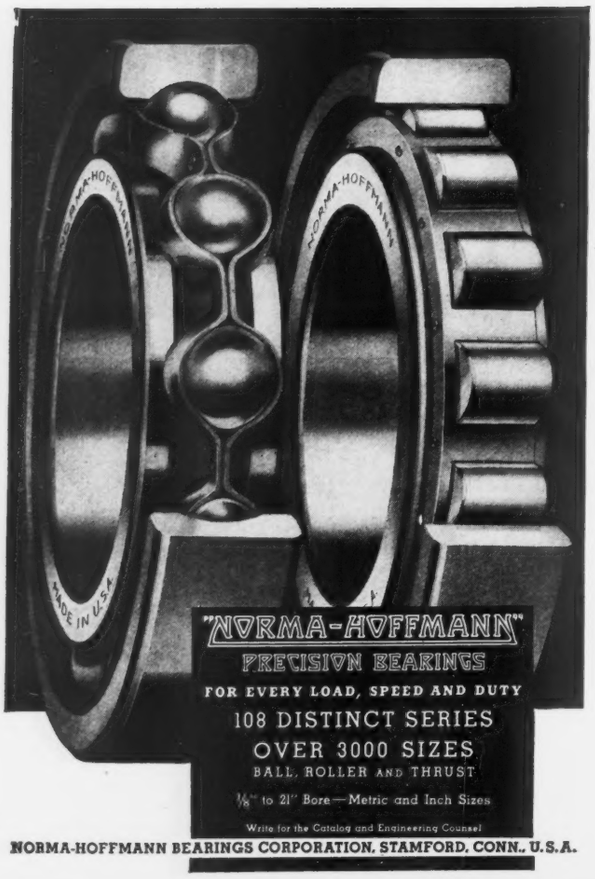


Left—The Sirocco Unit Heater for high ceiling industrial areas. Below—The Venturafin Unit Heater for all other industrial uses, stores, warehouses, garages, etc.

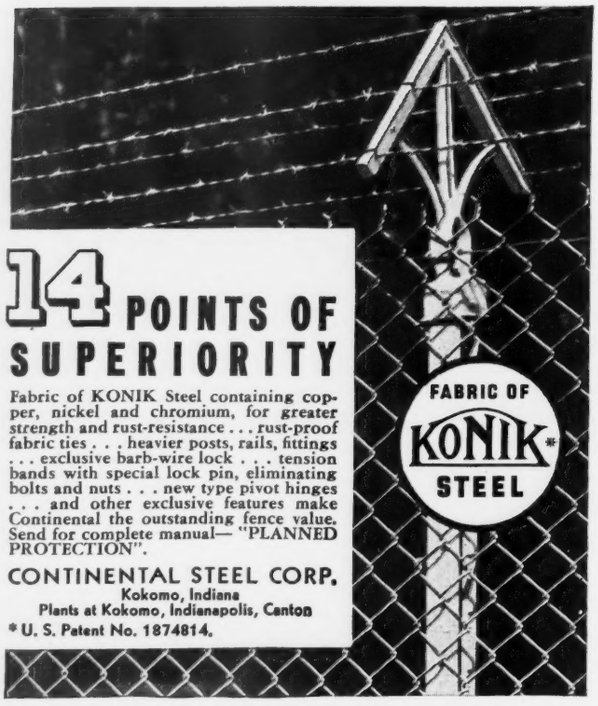
AMERICAN BLOWER
INDUSTRIAL UNIT HEATERS

AMERICAN BLOWER CORP. • DETROIT, MICH.

Division of American Radiator and Standard Sanitary Corp. • Canadian Sirocco Co., Ltd., Windsor, Ont.


"NORMA-HOFFMANN"
PRECISION BEARINGS
FOR EVERY LOAD, SPEED AND DUTY
108 DISTINCT SERIES
OVER 3000 SIZES
BALL, ROLLER AND THRUST
⅛" to 21" Bore—Metric and Inch Sizes
Write for the Catalog and Engineering Counsel

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U.S.A.



14 POINTS OF SUPERIORITY

Fabric of KONIK Steel containing copper, nickel and chromium, for greater strength and rust-resistance . . . rust-proof fabric ties . . . heavier posts, rails, fittings . . . exclusive barb-wire lock . . . tension bands with special lock pin, eliminating bolts and nuts . . . new type pivot hinges . . . and other exclusive features make Continental the outstanding fence value. Send for complete manual— "PLANNED PROTECTION".

CONTINENTAL STEEL CORP.
Kokomo, Indiana
Plants at Kokomo, Indianapolis, Canton
* U. S. Patent No. 1874814.

FABRIC OF KONIK* STEEL

CONTINENTAL *Chain Link* FENCE

"HALLOWELL" STEEL SHOP EQUIPMENT

"Hallowell" Steel Stools

The one piece welded steel construction of "Hallowell" stools and chairs makes them last longer — an important item when you're considering profits.

You can get just what you need in a "Hallowell" for the line is most extensive, with a design adapted for use at any type of operation.

Write us for our catalog.

Fig. 1334
Pat. Applied for

"Hallowell" Steel Tool Stands

Moves easily wherever it's needed; a handy stand to have. Made in a variety of types for all purposes.

Fig. 705

"HALLOWELL" STEEL WORK BENCH

Skillfully designed and built for present day needs. Its steel top stays smooth as a surface plate, and steel legs hold it permanently rigid. Bolt holes in the feet make it easy to fasten to the floor and easy to move. All its parts are standard and interchangeable. Best of all the cost is reasonable. Full range of sizes to choose from.

Fig. 732
Pat'd and Pats. Pending
Drawer is extra.

"HALLOWELL" STEEL TRUCKS

Fig. 754 Pat. Applied For

Made to withstand the toughest treatment. The steel platform can't splinter—their welded construction assures permanently rigid joints. And, because the wheels have smooth bores or anti-friction bushings in hubs and casters, and are perfectly lubricated, they're much easier to handle. Write for Bulletin.

STANDARD PRESSED STEEL CO.

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"HALLOWELL" FOREMAN'S DESK

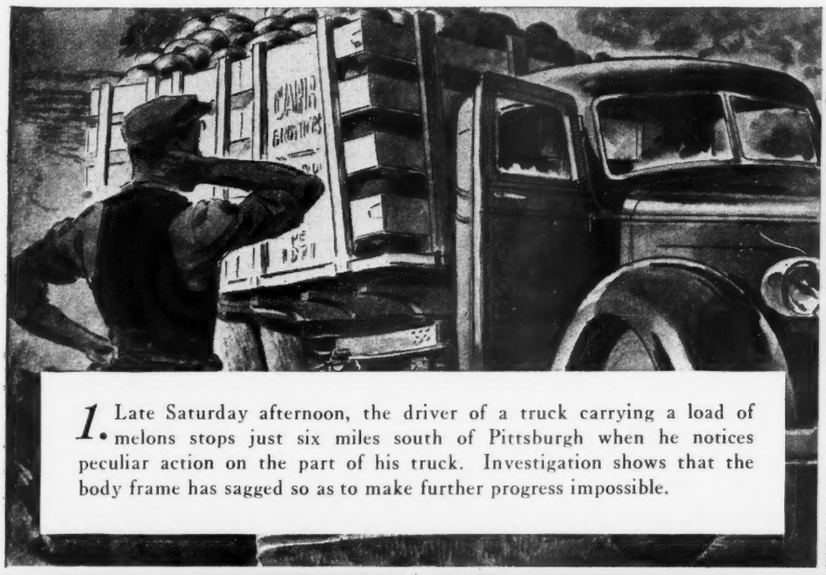
Ideal for foreman's use Right height . . . right incline to write on while standing. Large drawer with lock for holding valuable papers. Carried in stock for prompt deliveries.

Fig. 981 Pat. Pending

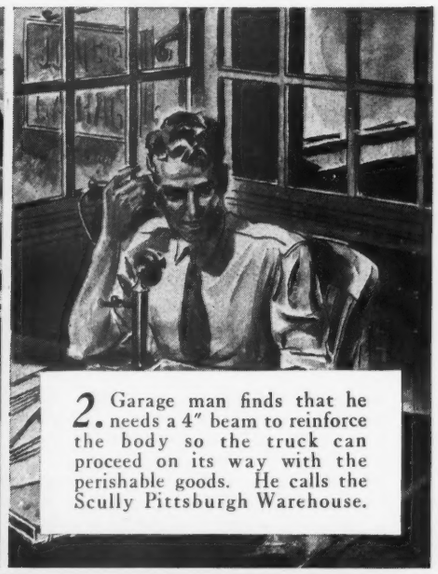
FOR LIFETIME WEAR AND ECONOMY

Phone call brings "SCULLY SERVICE"

. . . saves loss on Perishable Goods

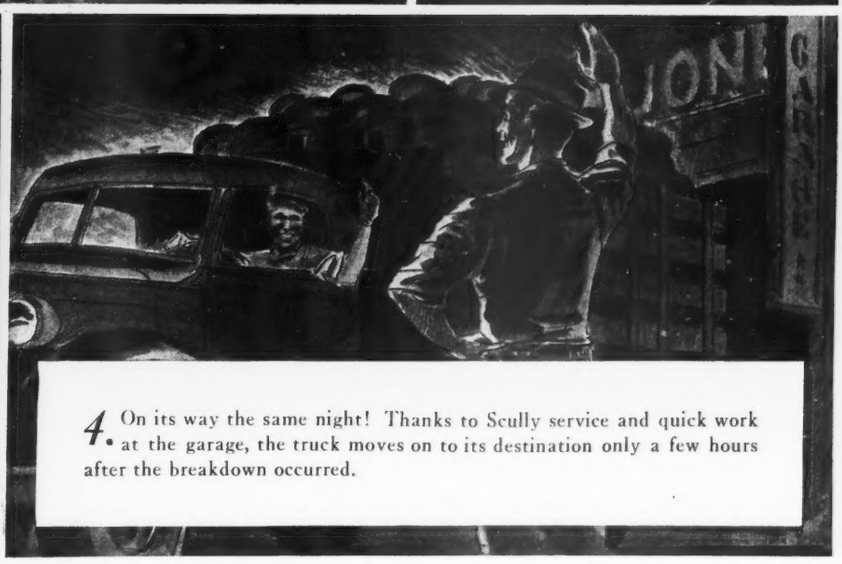


1. Late Saturday afternoon, the driver of a truck carrying a load of melons stops just six miles south of Pittsburgh when he notices peculiar action on the part of his truck. Investigation shows that the body frame has sagged so as to make further progress impossible.



2. Garage man finds that he needs a 4" beam to reinforce the body so the truck can proceed on its way with the perishable goods. He calls the Scully Pittsburgh Warehouse.

3. Saturday afternoon, but quick phone calls soon put Scully men on the job. In no time at all, the beam is cut and delivered to the garage.



4. On its way the same night! Thanks to Scully service and quick work at the garage, the truck moves on to its destination only a few hours after the breakdown occurred.

Scully Service

SMALL orders—large orders—rush or not, they all get Scully Service. Call Scully in emergencies and for your regular requirements, too. Every one of the eight Scully warehouses carries a big stock of steel, steel products, copper and brass.

Next time try Scully. Phone, wire or write the nearest Scully warehouse. Send for a free copy of our handy, complete Stock List and Reference Book. Remember: Scully Service is your insurance against delay.

SCULLY STEEL PRODUCTS COMPANY

Distributors of Steel, Steel Products, Copper and Brass

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CLEVELAND • PITTSBURGH • BALTIMORE

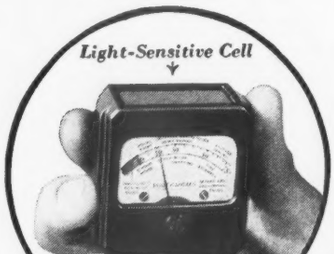
UNITED STATES STEEL

WHY G-E BULBS
give more light this year

Today's Edison MAZDA lamps actually give you more light than the same size lamps of a year ago . . . without using any additional current and without costing a penny more. And these new lamps *stay brighter longer* than ever before.

This is because constant improvement and technical development made in MAZDA lamp research laboratories have continually raised the efficiency of MAZDA lamps year after year. Whenever you buy these bulbs you get lamps that offer the advantages of the newest developments.

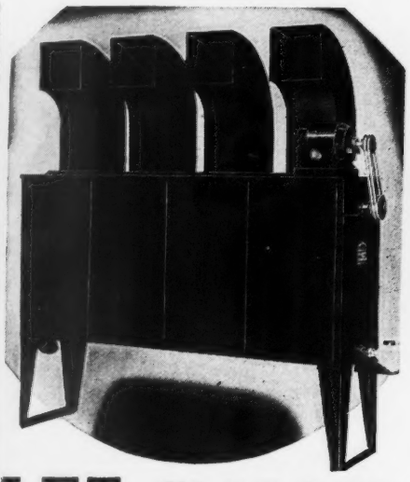
Next time you order lamps for your office, shop or factory, be sure to take advantage of the extra light these new, brighter G-E bulbs offer. Make sure that every bulb you buy carries the famous GE trade-mark. General Electric Company, Nela Park, Cleveland, Ohio.



USE THE G-E LIGHT METER TO MEASURE YOUR LIGHTING

The General Electric Light Meter tells whether employees are getting enough light for easy seeing, and is helpful in checking from time to time on whether this amount of light is being maintained. Costs only $11.50.

EDISON MAZDA LAMPS
GENERAL ELECTRIC



LET CLARAGE UNITHERMS DO YOUR FACTORY HEATING -- *Save Money in Fuel Cost*

Only Clarage Unitherm Unit Heaters offer Syncrotherm Control, a patented feature. Yet Syncrotherm Control is one of the most important improvements ever made in factory unit heating.

With this unique damper control, any desired temperature can be maintained by regulating (automatically or manually) the amount of air passing **through and around** the heating coil.

Syncrotherm Control provides uniform heating with **relatively low temperature air.** The fans operate continuously during working hours. This eliminates cold floors and hot ceilings — no heat wasted! The result: **better heating plus remarkable savings in fuel cost.**

UNITHERM FEATURES

1. **Furnished for floor or suspended installation, using steam or hot water.**
2. **Heating coil good for pressures up to 200 pounds.**
3. **Equipped with centrifugal fans —ideal for wide area heating.**
4. **Every part accessible.**
5. **Large range of sizes.**

Clarage Heaters for Small Jobs

Easily installed—suspended from wall or ceiling. Quiet in operation. Sizes to meet various needs with maximum heating efficiency.

25 YEARS' EXPERIENCE

By continual research and constant product improvement, Clarage has maintained leadership in this ONE field. You can profit by our long experience. No matter how unusual your heating problem, we can meet your particular requirements with UTMOST ECONOMY. Write us!

SPECIFY CLARAGE for
COMPLETE AIR CONDITIONING
VENTILATION
HEATING
COOLING
MECHANICAL DRAFT
FANS & BLOWERS FOR INDUSTRIAL NEEDS

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN

Heat-Resistant Plastics

...FOR VARIED TEMPERATURES

Typical applications: ovenware handle, magneto lead-out and sterile hospital siphon part, respectively of High Heat-Resistant, Medium High Heat-Resistant, and General Purpose Bakelite Molded.

AN OUTSTANDING advantage of Bakelite Molded to industrial engineers and designers is its availability in numerous special types that accurately fulfill different specific requirements. For products that must withstand temperatures above the normal atmospheric range, for example, Bakelite Molded offers three distinct types adapted to successively higher degrees of temperature.

General Purpose Bakelite Molded has long been noted for its ability to retain its strength, form and lustre at temperatures up to 300°F. *Medium High Heat-Resistant* Bakelite Molded possesses similar integrity in service up to 400°F. And *High Heat-Resistant* Bakelite Molded now makes practical the use of molded plastics for service up to 500°F.

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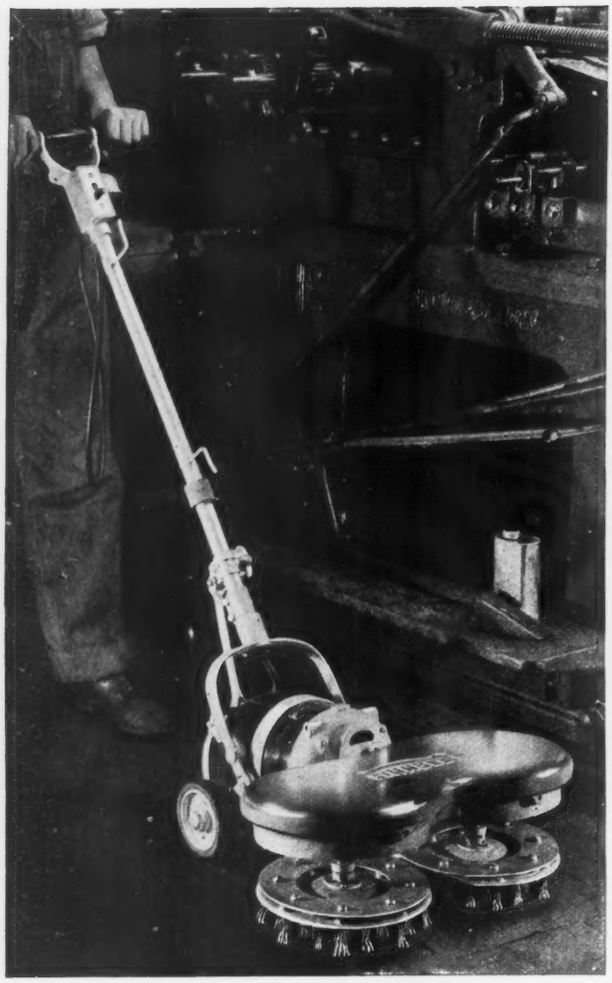

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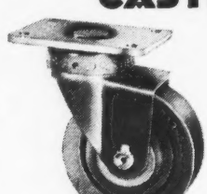

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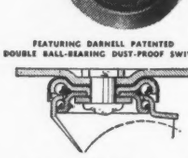

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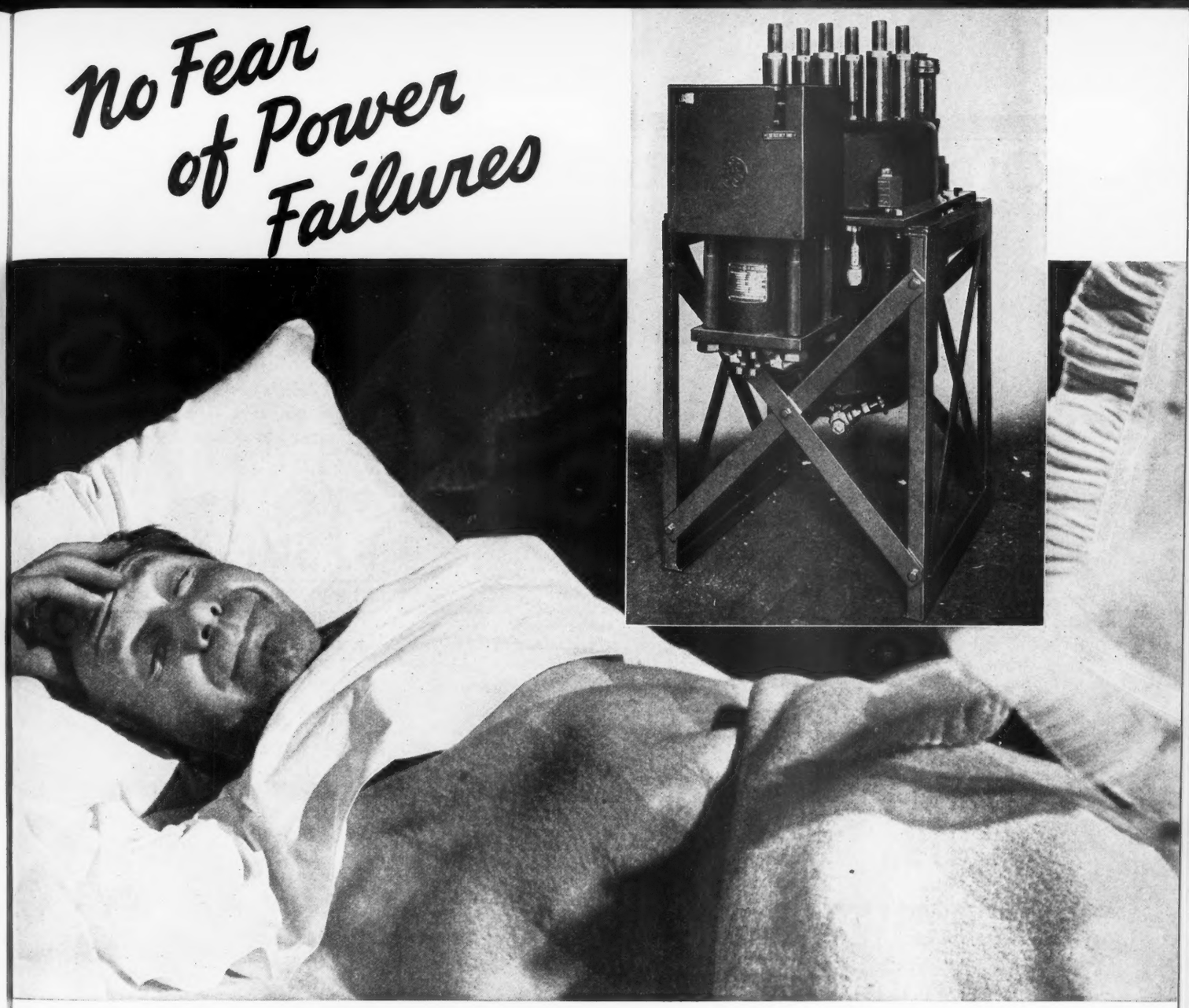

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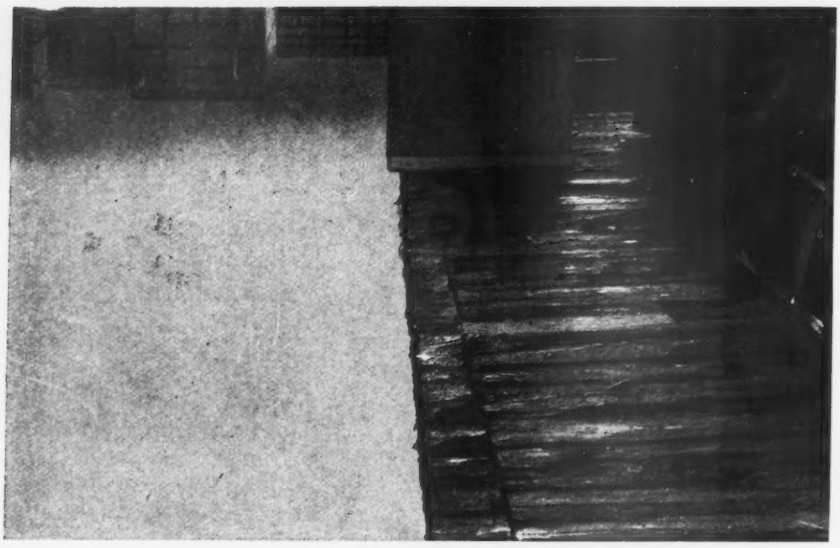

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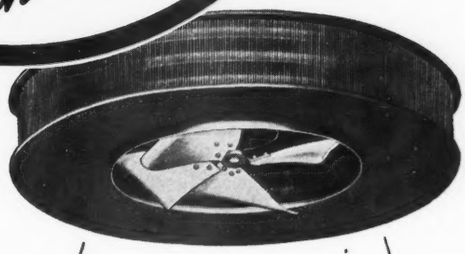

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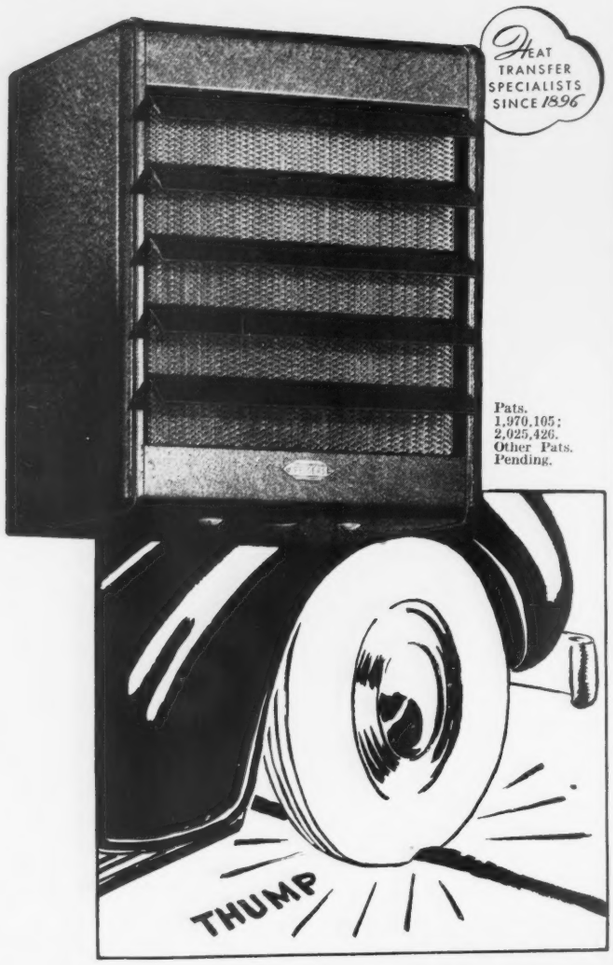

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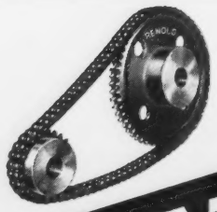

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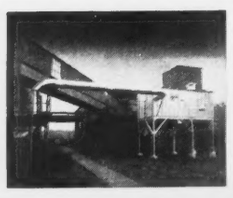

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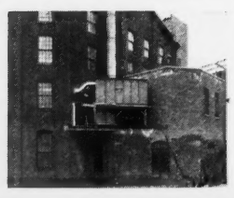

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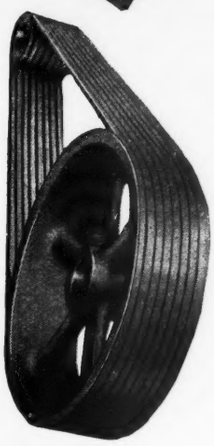

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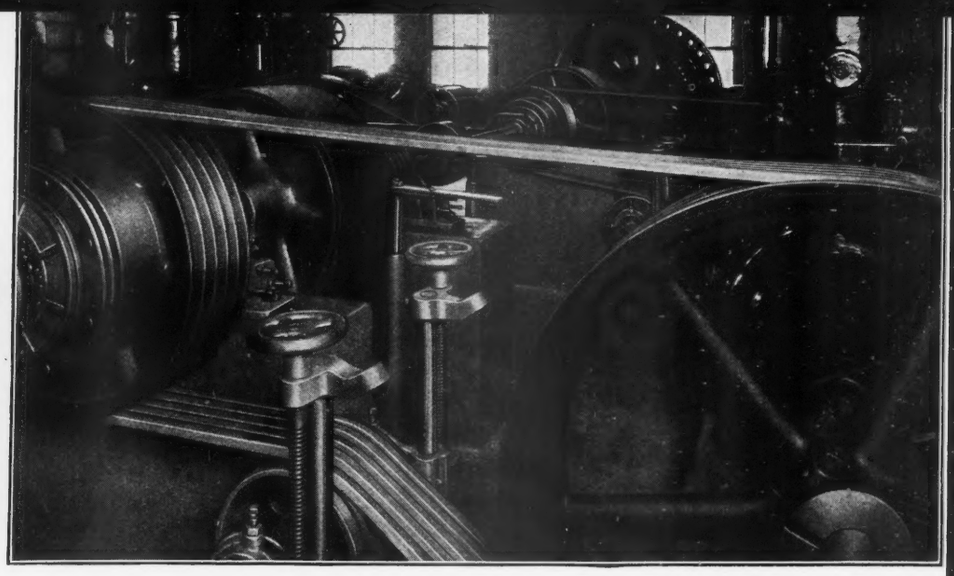

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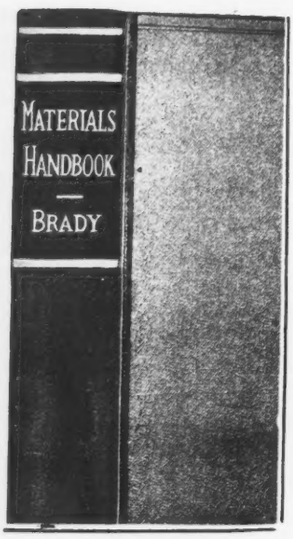

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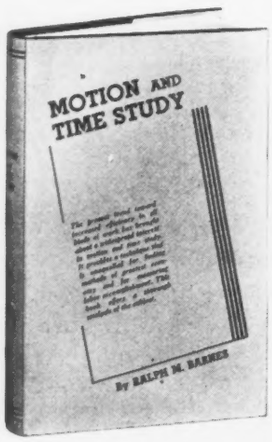

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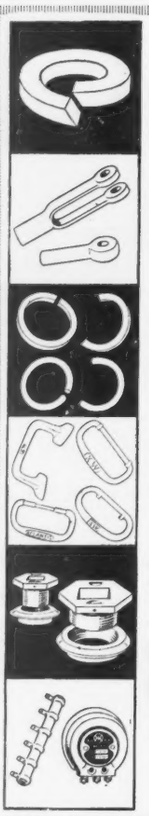

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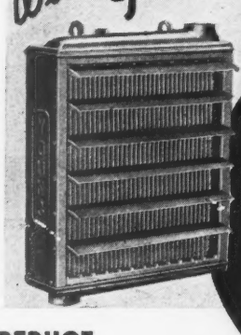

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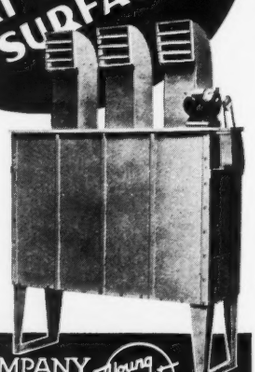

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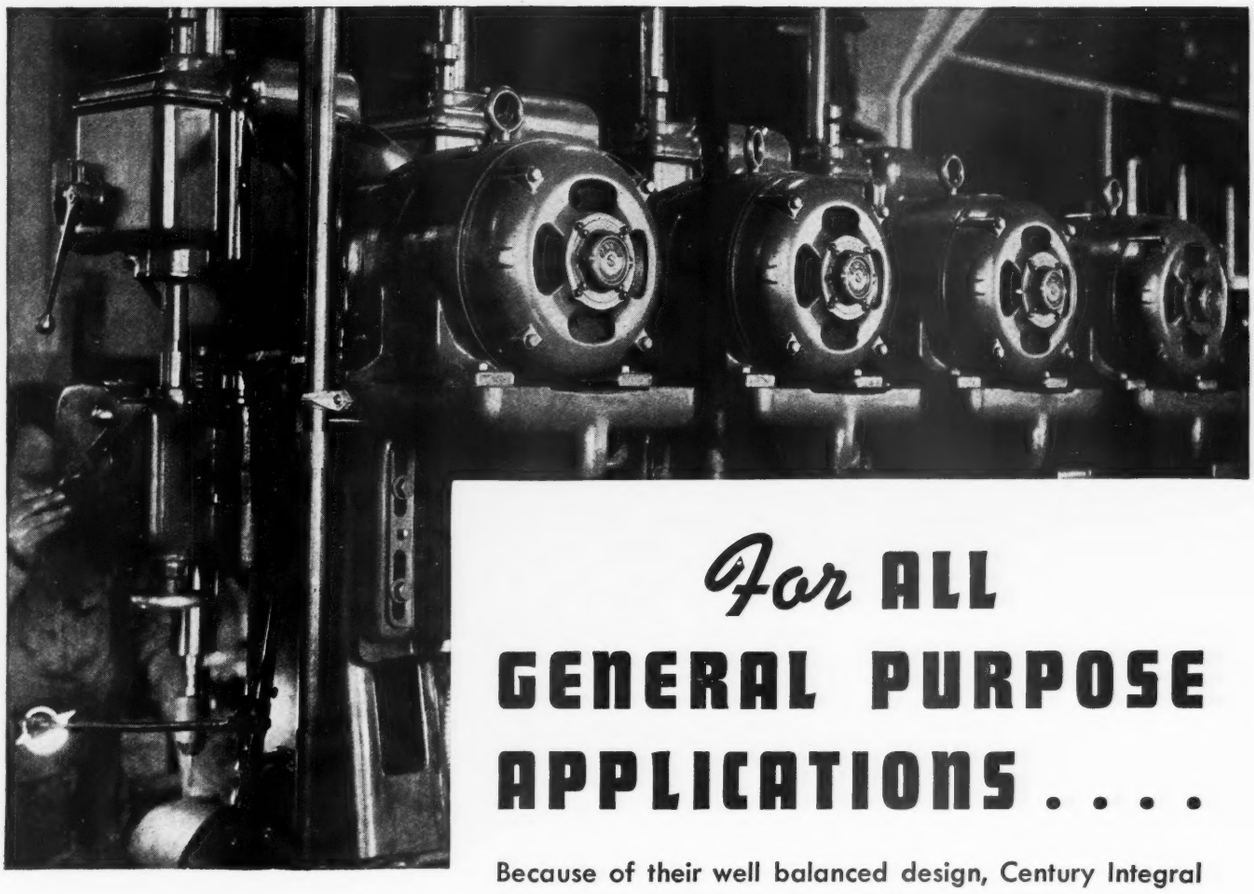

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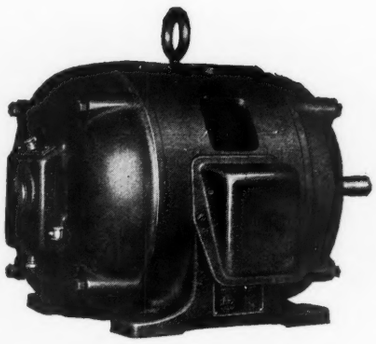

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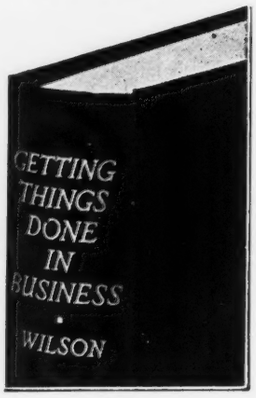

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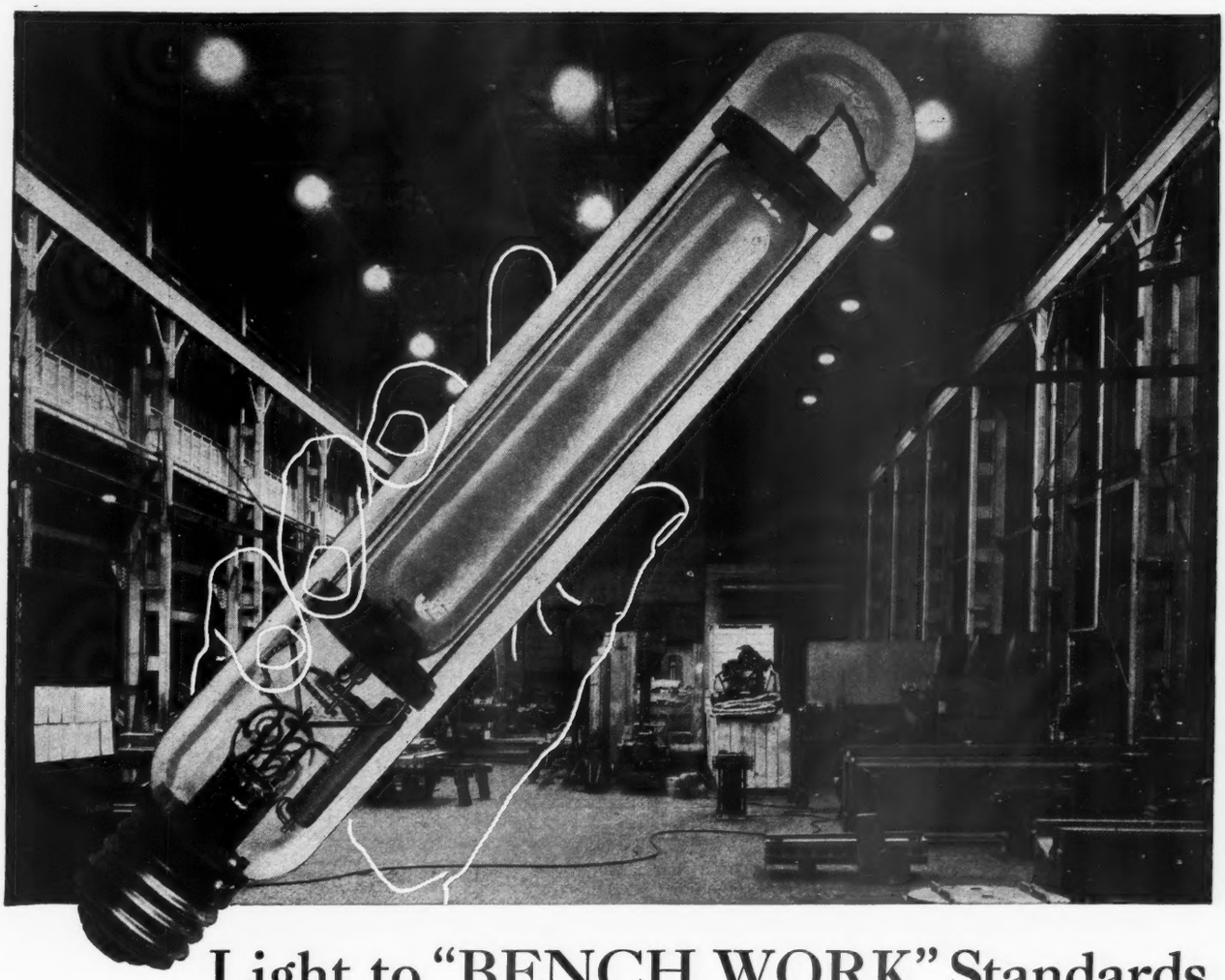

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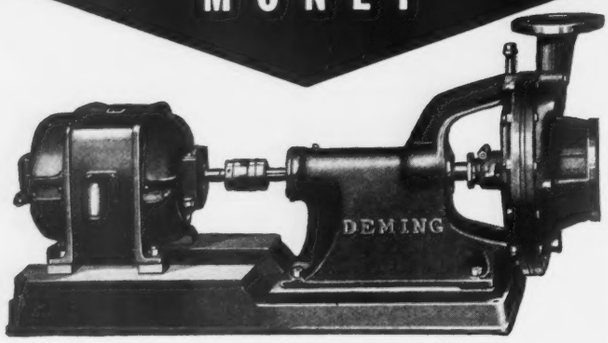

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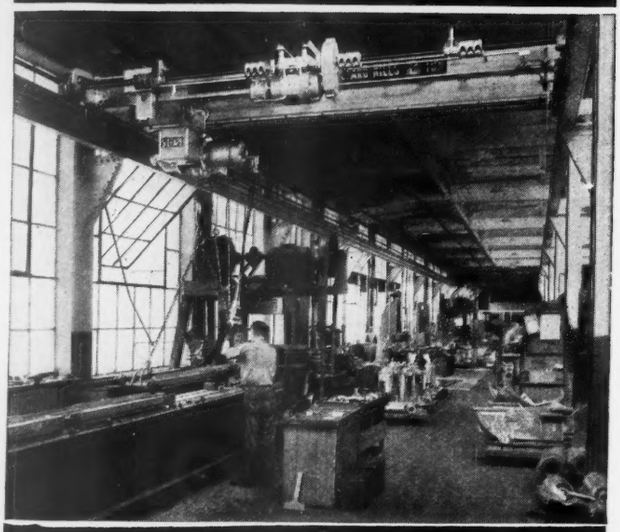

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No. 12443 Storage Cabinet

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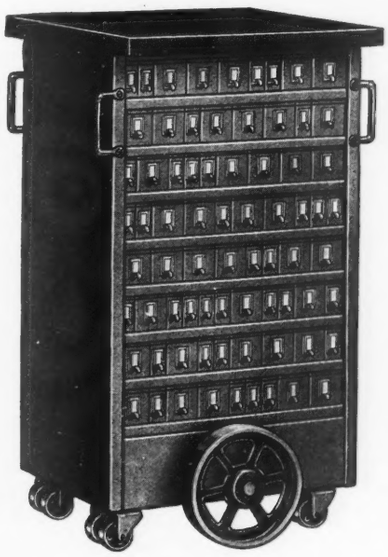
FOR SMALL PARTS . .

Note sectional construction of the cabinet shown below . . . you can add to these units at any time . . . stack them two or three high. Individual boxes, each with a label holder and a pull, are used in it. Two box sizes are available. Each shelf will take any combination of the large and small boxes. Height of cabinet is 38½″. Floor space required, 11¼″ x 20⅜″.



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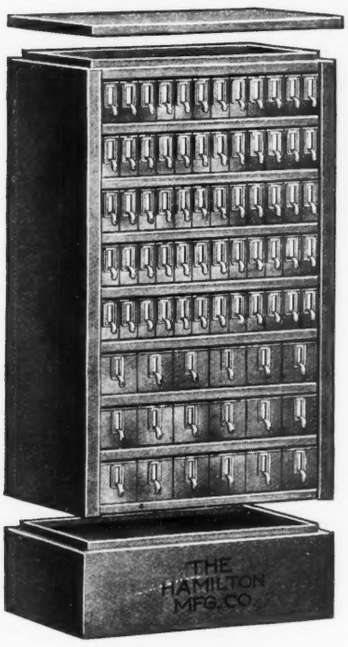
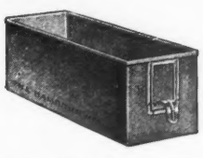


No. 13440 Cabinet

No. 13452 Steel Box with label holder pull; size 1½ x 3 x 6 in.



No. 13454 Steel Box with label holder pull; size 3 x 3 x 6 in.

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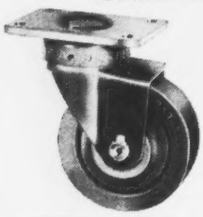

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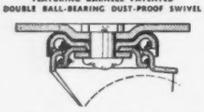

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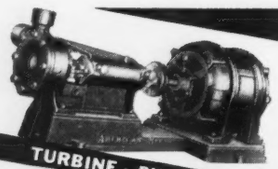

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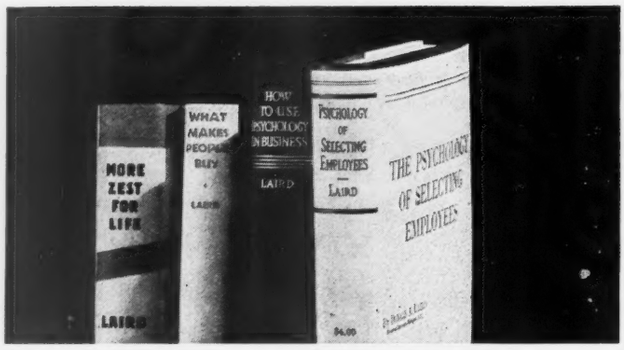

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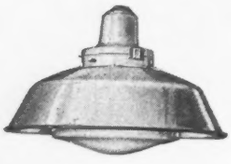

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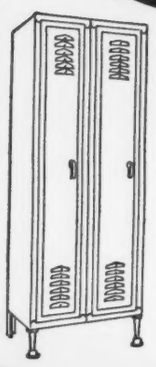

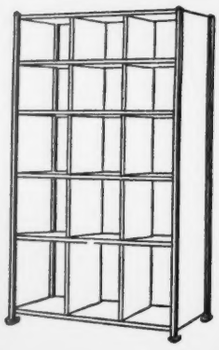

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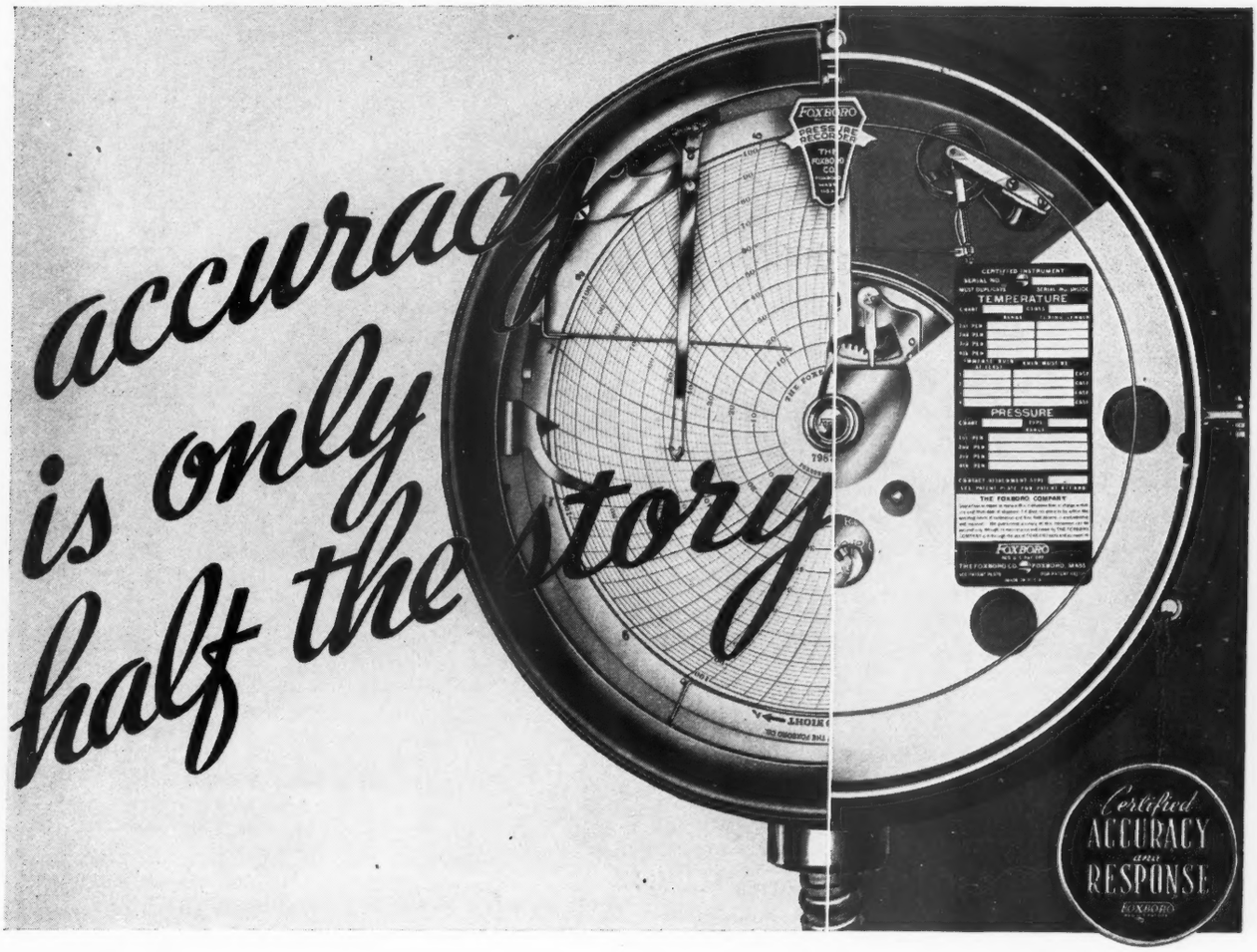


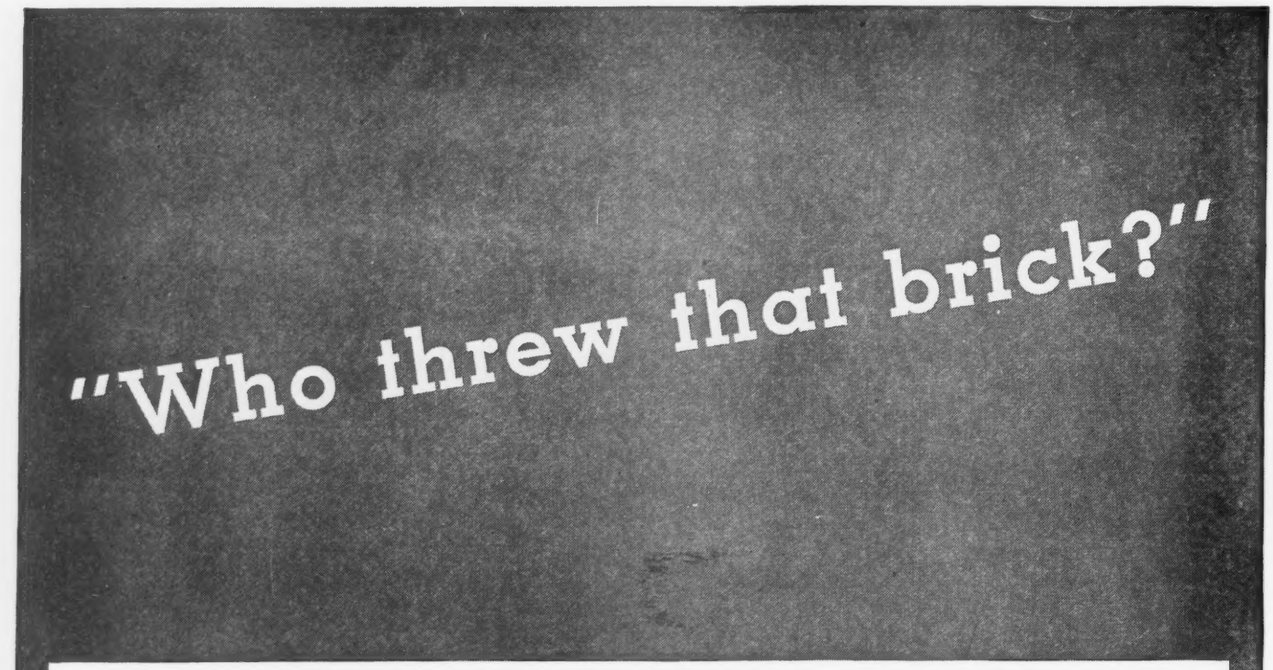
You get every feature essential to economical operation in Foxboro *mono-therm* Recording Thermometers. Accuracy and response are unequalled. The *mono-therm* System is *new*, made by a process scientifically controlled to make it an unusually strong and wear-proof unit.

Friction and inertia are minimized because the moving parts are extremely light and strong. Fixed parts are heavy to assure permanent alignment. There is no lost motion. Practical knowledge of user requirements is emphasized in the design and workmanship of Foxboro *mono-therm* Thermometers. They have proved their capacity to carry the Foxboro certification of unequalled response and accuracy.

Bear in mind: Foxboro certifies the performance of each instrument . . . certain protection for you . . . available to every one who uses Foxboro *mono-therm* Thermometers. The Foxboro Company, 24 Neponset Avenue, Foxboro, Massachusetts, U. S. A. Branch offices in 25 Principal Cities.

FOXBORO
REG. U. S. PAT. OFF.
mono-therm
RECORDING
THERMOMETERS

1. ***Faster response***—exact temperature on time.
2. ***More accurate***—precision over the entire scale range.
3. ***Last longer***—friction minimized; alignment permanent.
4. ***Less maintenance***—less wear and no leakage.
5. ***mono-therm System***—finest thermal unit construction.
6. ***Individually certified***—your guarantee of satisfactory instruments and performance.



THERE WERE two rival manufacturers in a highly competitive line. Both were good fellows, and both made good products.

But one day an over-enthusiastic copywriter wrote, for one of them, an advertisement that, to the other, looked like a direct dig.

"Two can play at that game!" raged the No. 2 manufacturer. "*Slap back at 'em!*" he told his copywriters. "*Give 'em as good as they send!*"

And the Fight Was On

The battle raged for months . . . the air was filled with bricks . . . and the magazine publishers found themselves caught in the middle.

The publishers stood it as long as they could before appealing to the National Better Business Bureau.

"See if you can settle this thing," they asked us. "It's hurting every one involved."

We visited executives of both companies and asked them to meet with us. It was a very unpleasant meeting for about two hours as they argued bitterly. Then things began to calm down.

Finally they agreed that a little co-operation would help, shook hands, and the fight was over—to their own profit and the delight of the publishers.

• • •

The National Better Business Bureau is a non-profit corporation maintained by more than 600 firms, which believe that business should defend itself against practices that destroy public confidence. Its cases are handled confidentially, and are usually settled by a fair discussion of the facts.

The Bureau will gladly help you with your problems. To know more about the Bureau and what it can do for you, send the coupon today for our free booklet, "*How to Use the National Better Business Bureau.*"

National Better Business Bureau, Inc.
405 Lexington Avenue, New York City.
Please send me a copy of "How to Use the National Better Business Bureau."

*Name*_____

*Firm Name*_____

*Address*_____

*City*_____ *State*_____

FACTORY MANAGEMENT AND MAINTENANCE

Equipment—Material—Supplies — *SERVICE SECTION* — *For Plant—Mill—Factory*

SPROCKETS

45,000 in stock for block, roller and silent chains.

Special sprockets are made for your requirements.

Speed Reducers. Lathe Drives

Write for New Catalog

CULLMAN WHEEL COMPANY

1325 Altgeld St., Chicago

EMPLOY CESCO RESPIRATORS

to protect your men from obnoxious and injurious fumes, gas, smoke, dust.

CONSERVE MAN VALUES

Cesco Respirators are light, strong and efficient. Their cost is a trifle contrasted with the worth of the service they render your men—and YOU.

CHICAGO EYE SHIELD COMPANY

2331 Warren Blvd., Chicago, Ill.

ELECTRIC VALVES

Automatically Controlled by

THERMOSTAT
TIME SWITCH
OR
FLOAT SWITCH
AC or DC

Can be applied to air, water, gas, liquid, oil, etc.

Thousands in use, minimum servicing.

Write for full data.

ELECTRIC VALVE MFG CO., Inc.

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MODERNIZE your card filing systems and business data with

FINDEX

A filing system that automatically, mechanically and quickly classifies, analyzes, selects, sorts all kinds of business facts and records.
It almost thinks, and never makes a mistake. Used for sales, collection, personnel, customer, membership, patents, research, statistical and other records. WRITE today and find out how Findex will save time and money for you.

FINDEX SYSTEMS, INC.

245 E. Erie St., Milwaukee, Wis.

30 DAY FREE TRIAL OFFER!

Multibrip

Skid Boxes • Box Trucks
Shipping Boxes

G. B. LEWIS CO., Dept. X, Watertown, Wis.

New Advertisements

must be received by November 18th to appear in the December issue.

Address copy to the Departmental Advertising Staff

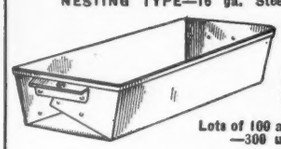
Factory Management and Maintenance

330 West 42d St., New York City

TOTE PANS

(20" x 12" x 6½")

NESTING TYPE—16 ga. Steel



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Lots of 50 $1.00 each

Lots of 100 and 200 less 3%
—300 up less 5%

Strong Handles with Drag Holes

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BRIDGEPORT, CONN.

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OLIVER FIELD ALLEN

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Fellow: A.I.E.E. Member: A.S.M.E., S.A.E.
Am. Chem. Soc., Soc. Am. Mil. Engrs
Consulting Engineer
Diesel Engines, International Engineering Liaison.
Gas and Oil Engine Power Applications.
Regular Foreign Correspondents.
117 Liberty Street, New York City
Cable Address: OFALL-New York

CALIBRON PRODUCTS, Inc.

West Orange, N. J.
Mechanical and Electrical Engineering
"GUARANTEED RESEARCH"
Special Apparatus Developed and Built to order

THE EMERSON ENGINEERS

30 Rockefeller Plaza, New York — 11 So. LaSalle St., Chicago

INDUSTRIAL ADMINISTRATION AND MANAGEMENT COUNSELORS

(Since 1899)

The Trend Toward Economy—

The service of the consulting engineer is a real economy. With his knowledge of organization and production problems and his wide and varied experience, he can usually reveal the points of waste and inefficiency that are costing you money and suggest inexpensive means for their elimination.

METHODS ENGINEERING COUNCIL, INC.

MOTION AND TIME STUDY — INDUSTRIAL MANAGEMENT
INSTRUCTION — CONSULTATIONS
TRAINING — INSTALLATIONS

Wood and Franklin Streets, Station 21
Pittsburgh, Pa.

ALLAN H. MOGENSEN

Industrial Consultant

330 W. 42nd Street
NEW YORK CITY

JOHN W. POOLE

Petroleum Chemist

Specializing in the use, manufacture and regeneration of lubricants.

369 Lexington Ave., New York, N. Y.

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

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15 cents a word, minimum $2.00 an insertion.

(See ¶ on Box Numbers)

Positions wanted (full or part-time salaried employment only), ½ the above rates.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 inch $8.00
2 to 3 inches ..... 7.80 an inch
4 to 7 inches ..... 7.60 an inch

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page. Contract rates upon request.

F.M.M.

Copy for new advertisements must be received by November 18th for the December issue

POSITION VACANT

WANTED MANAGER REBUILDING department. Must possess thorough knowledge of machinery and machine design. Have initiative and experience in various phases of metal working (not metallurgy) must possess executive ability to manage a department of about 30 men. Salary to be determined by meeting of principals. Some machine shop foreman or minor executive will find this opportunity exceptional. Plenty of room for growth for the right man. P-436, Factory Management and Maintenance, 330 West 42nd Street, New York City.

POSITIONS WANTED

INDUSTRIAL ENGINEER, '37 graduate. Interested in production planning and control. PW-431, Factory Management and Maintenance, 330 West 42nd Street, New York City.

EQUIPMENT DEVELOPMENT ENGINEER—36, married, excellent experience in the development of new processes and design of complicated automatic machinery and shop equipment desires position requiring skill, imagination and inventive ability. PW-433, Factory Management and Maintenance, 330 West 42nd Street, New York City.

COST ACCOUNTING and budgetary control. Constructed and managed cost and budgetary system for subsidiary of one of largest national corporations. PW-434, Factory Management and Maintenance, 520 No. Michigan Ave., Chicago, Ill.

FACTORY or WORKS MANAGER. 18 years executive experience in metal industry, production control, tool room and plant maintenance, male and female help. Wish to make connection with growing concern. Age forty-two. PW-435, Factory Management and Maintenance, 520 No. Michigan Ave., Chicago, Ill.

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WANTED: Ambitious and experienced electrical maintenance engineer with $10,000.00 to buy active interest in long established Electric Motor Service Shop. References required. BO-432, Factory Management and Maintenance, 330 West 42nd Street, New York City.

WANTED

ANYTHING within reason that is wanted in the field served by Factory Management and Maintenance can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

SALARIED POSITIONS
$2,500 to $25,000

This thoroughly organized advertising service of 27 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details.

R. W. BIXBY, INC.
276 Delward Bldg., Buffalo, N. Y.

GENERAL MANAGER WANTED

A medium sized concern in New England is looking for a man to head up its business.

He must have tact, ability, aggressiveness and integrity. The concern has a high standing in its field, plenty of orders on its books, but a man is wanted with vision enough to enlarge its operations along effective and stable lines. Mechanical experience is desirable but not absolutely necessary. No one over 45 will be considered. A fine opportunity for the right man.

P-432, Factory Management and Maintenance,
330 W. 42d St., New York City.

EXECUTIVES AND TECHNICAL MEN

Contact selected employers in any territories through our confidential and effective methods. Established 22 years. Write.

THE NATIONAL BUSINESS BOURSE
H. H. HARRISON, Director
20 W. Jackson Blvd., Chicago

Motion and Time Study Training

Effective factory operation demands men trained in the new methods of cost reduction through job analysis and work simplification. Methods Engineering positions await trained men. Write for Booklet describing our home study training courses in Methods Engineering, Motion and Time Study, and Time Formula Derivation.

Methods Engineering Council Extension
Wood & Franklin Sts., Pittsburgh, Pa.

LEGAL NOTICE

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933

Of Factory Management and Maintenance, published monthly at Albany, N. Y., for October 1, 1937.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared D. C. McGraw, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Factory Management and Maintenance, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, N. Y. C. Editor, L. C. Morrow, 330 West 42nd Street, N. Y. C. Managing Editor, none. Business Manager, A. M. Staehle, 330 West 42nd Street, N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) McGraw-Hill Publishing Company, Inc., 330 West 42nd St., N. Y. C. Stockholders of which are: James H. McGraw, 330 West 42nd St., N. Y. C. James H. McGraw, Jr., 330 West 42nd St., N. Y. C. James H. McGraw, James H. McGraw, Jr., and Curtis W. McGraw, 330 West 42nd St., N. Y. C., Trustees for: Harold W. McGraw, James H. McGraw, Jr., Donald C. McGraw, Curtis W. McGraw, Curtis W. McGraw, 330 West 42nd St., N. Y. C. Donald C. McGraw, 330 West 42nd St., N. Y. C. Anne Hugus Britton, 330 West 42nd St., N. Y. C. Mildred W. McGraw, Madison, N. J. Grace W. Mehren, 33 West Grand Ave., Chicago, Ill. J. Malcolm Muir and Guaranty Trust Co. of New York, Trustees for Lida Kelly Muir, 524 Fifth Avenue, N. Y. C. F. S. Weatherby, 271 Clinton Road, Brookline, Mass. Elsa M. Wilsey, Madison, N. J.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is. (This information is required from daily publications only.)

D. C. McGRAW, Secretary,
McGRAW-HILL PUBLISHING COMPANY, INC.

Sworn to and subscribed before me this 27th day of September, 1937.

[SEAL] H. E. BEIRNE,

Notary Public, Nassau County. Clk's No. 74. N. Y. Clk's No. 192, Reg. No. 8-B-115.

(My commission expires March 30, 1938)

FOR SALE
(Additional For Sale Ads Continued on the opposite page)

GOOD USED STEEL STRUCTURES

50'x300' 90'x195' 110'x400'
62'x400' 130'x195' 270'x600'

We Buy and Sell Steel Structures!

IRON AND STEEL PRODUCTS, INC.
CHICAGO (Hegewisch Sta.), Ill. SOUth Chgo. 9430
"Anything containing IRON or STEEL"

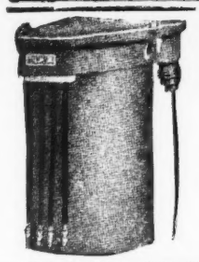
Truck Casters For Sale

Several hundred 2" to 4" Service and Phoenix Casters. Single and double wheel. Swivel, ball bearing, roller bearing, and straight. Will sell all or part at forty-five cents each.

Patterson Manufacturing Company
Denison, Texas

WHEN answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

—TRANSFORMERS—



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3—500 KVA Wagner Transformers, 60 cycle, 4000-460 volts **$910.00** EACH

We Rewind, Repair and Redesign all Makes and Sizes.
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
Write for Catalog No. 132-D

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M CINCINNATI, OHIO

FOR SALE

IMMEDIATE DELIVERY

Reasonably Priced

Air Compressors—Conveyor Type Japan Baking Ovens—Metal Washing Machines—Impregnating Equipment—Sheet Metal Working Machines—Hydraulic Presses—Sullivan & Buffalo Vacuum Pumps—Air Filters—Hydraulic Pumps — Kingsbury Drillers — Anderson Tappers — Carton Sealing Machines—Overhead Conveyors—Paper Tube Machines—Wood Working Machines—Artos Wire Machines—Drill Presses—Sand Blast Machines—Electro Platers—B & S Hand Screw Machines—Lathes—Millers—Spot Welders — Bench Conveyors — Grinders — Buffers — Planers — Slitter — Punch Presses — Gas Furnaces — Spray Booths — U.S.M.C. & Peerless Eyelet Machines—Condenser and Coil Winders — Factory Chairs — Steel Shelving — Factory Trucks — Overhead Cranes—Electric Time Clocks—Electrical and Testing Equipment.

This is a Partial List—Catalog on Request

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4700 Wissahickon Ave. Phila., Pa.

BARGAINS IN PULLEYS

250 Pulleys 6" to 128" diameter, various faces and bores; steel split, C. I. split, C. I. solid, for sale singly at one-half new list price or will accept offers for entire lot. Located Hartshorne, Oklahoma.

Write P. O. Box 3046, Houston, Texas

ELECTRICAL MACHINERY

Motors and Generators, A.C. and D.C. for sale at Attractive Prices. Large Stock. New and Rebuilt All Guaranteed. *Write for Stock List and Prices.*

V. M. NUSSBAUM & CO.
FORT WAYNE, IND.

• GUARANTEED REBUILTS •

SPECIAL 2—1250 KW CONDENS. TURBO GENERATOR SETS ALSO—1250 KVA. 2300-3-60 CONDENSER MG SETS
2-750 KW Sync.—125 v.
1-225 KW Syn. compl.
1-150 KW G.E. Syn.
1-100 KW Sync. compl.

SYNCHRONOUS MTRS.
1-1000 hp Cr. Wh. 600 rpm
1-750 hp E.Mch. 514 rpm
1-315 hp G.E. 600 rpm
1-200 hp Cr.-Wh. 600 rpm
1-200 hp Wgse. 225 rpm
1-150 hp Burke 600 rpm
1- 75 hp G.E. 600 rpm

AC GEN.
1-1250 kw Ideal 1200 rpm
1-1000 KW G.E. 257 rpm
1-750 KVA 200 rpm
1-750 KW Cr. Wh. 600 rpm
1-500 KW E.Mch. 514 rpm
1-375 KVA G.E. 225 rpm
(Many in smaller capac.)

SLIPRING MOTORS
1-500 hp Al.-Ch. 450 rpm
2-300 hp Wgse. 360 rpm
3-200 hp Al.-Ch. 720 rpm
1—200 hp Burke 900 rpm
1-200 hp G.E. 600 rpm
Write for Large Squirrel Cg. List

SURFACE CONDENSER
4000 Sq. Ft. Worthington

COMPLETE STOCK SMALL EQUIPMENT
New Catalog on Request

CHICAGO ELECTRIC CO.
1326 W. 22nd St. CHICAGO, Ill.

A.C. MOTORS
3 Phase, 60 Cycle

H.P.	Type	Speed
1500	G.E., syn.	180
1500	West. sl. rg.	440
1000	West. synch.	900
850	West. sl. rg.	710
500	Allis. Ch. sl. rg.	500
450	West. sl. rg.	875/700
400	G.E. sl. rg.	390
400	West. sl. rg.	450
375	G.E. syn.	600
350	Cr. Wheel syn.	720
300	G.E. syn.	600
300	Al. Ch. sl. rg.	585
250	West. sl. rg.	500
250	G.E. sl. rg.	257
225	El. Mchy. syn.	450
225	G.E. sl. rg.	1800

DIESEL ENGINE GENERATOR SETS
200 H.P. McIntosh & Seymour, 8 cy. V-type Diesel, 500 rpm, direct con. 135 KW. D.C. G.E. gen. Note. Can furnish AC gen.

ROTARY CONVERTER
1—500 K.W. G.E. HCC 8-500-1200 Form P D.C. 600 v. A.C. 2300/4000 v., 3 ph., 60 cy. comp. with trans.

CENTRIF. PUMPS
2500 GPM. Delaval type 10, 159'-75 lb. 10", S. Stage, D. Suction.

Above are a few of our stock items

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REBUILT GUARANTEED

We
- Sell
- Buy
- Rent
- Repair
- Exchange
- All Makes
- and Sizes

GREGORY HI-GRADE-REBUILT
•
MOTORS GENERATORS TRANSFORMERS METERS, FANS, PUMPS, ETC.
•
Always Dependable —Economical—
•
Money-Back Guarantee
•
GREGORY ELEC. CO.
1606 South Wolcott Avenue "formerly Lincoln Street"
CHICAGO

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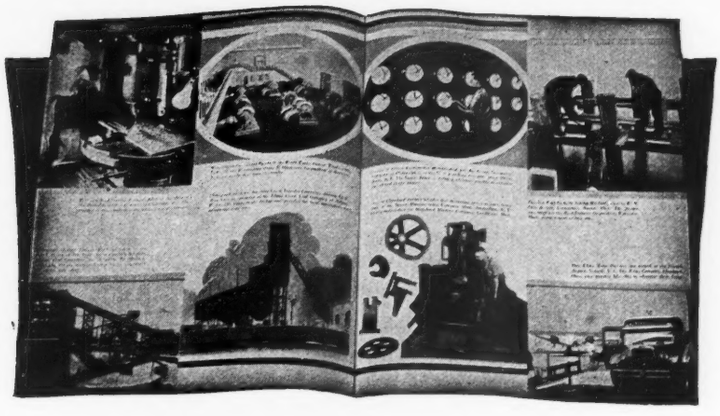

made on the job tell the story!

ACTION PICTURES . . . .
PRODUCT ILLUSTRATIONS
EQUIPMENT PHOTOGRAPHS
INSTALLATION SCENES
PROGRESS PHOTOGRAPHS

Send for this descriptive folder

FIELD PHOTO SERVICE
McGraw-Hill Publishing Company, Inc.
330 WEST 42nd STREET, NEW YORK

WHETHER it's a product or piece of equipment to be sold, a report to be illustrated, or the progress of a job to be recorded, actual photographs tell the story better than words . . . Here is a photographic service prepared to secure first class pictures, promptly and at minimum cost, through carefully selected commercial photographers in all parts of the United States and Canada.

INDEX TO ADVERTISEMENTS

Page

Acme Steel Company.....132, 141
Alan Wood Steel Co.....217
Alemite Div. Stewart-Warner Corp. 121
Alexander Brothers, Inc.....202
Allen, Oliver Field.....245
Allen-Bradley Co., insert between 34 and 35
Allis-Chalmers Mfg. Co.....152
All-Steel-Equip Co.....162
American Air Filter Co.....201
American Blower Corp.....219
American Chain Div. A.C.C.O.....197
American Hammered Piston Ring Div. of Koppers Co. insert between 218 and 219
American-Marsh Pumps, Inc.....240
American Monorail Co.....156
American Mutual Liability Ins. Co. 22, 23
American Optical Company.....34
American Pulley Co.....30
American Steel & Wire Co.....182
Anaconda Wire & Cable Co.....36, 37
Arrow-Hart & Hegeman Elec. Co..215
Bakelite Corp.....223
Baker-Raulang Company.....32
Bartlett-Hayward Div. of Koppers Co. insert between 218 and 219
Bassick Co.....179
Benjamin Electric Mfg. Co.....119
Birdseye Electric Co.....150
Black & Decker Mfg. Co.....249
Blaw-Knox Co.....177
Bond Fdry. & Mach. Co.....132
Boston Gear Works, Inc.....228
Boston Woven Hose & Rubber Co., insert 193, 194, 195, 196
Browning Crane & Shovel Co.....148
Buffalo Forge Company.....35
Buffalo Pumps, Inc.....216
Bull Dog Electric Prod. Co.....31
Bussmann Mfg. Co.....26, 27
Calibron Products, Inc.....245
Carey Co., Philip.....160
Carrier Corp.....171
Central Iron & Steel Co.....50
Century Electric Company.....233
Chase, Frank D.....245
Chicago Eye Shield Co.....245
Chicago Rawhide Mfg. Co.....145
Clarage Fan Co.....222
Clark Controller Co.....133
Clark Tructractor.....103
Clipper Belt Lacer Co.....125
Colt's Patent Fire Arms Mfg. Co....137
Consolidated Expanded Metal Cos...134
Continental Steel Corp.....220
Coppus Engrg. Corporation.....208
Crane Co.....207
Crocker-Wheeler Elec. Mfg. Co.....203
Cullman Wheel Company.....245
Darnell Corp., Ltd.....224, 240
Dayton Safety Ladder Co.....166
Deming Co.....236
Detroit Steel Products Co.....138
De Vilbiss Company.....180
Diehl Mfg. Co.....211
Disston & Sons, Inc., Henry.....186
Dixon Crucible Co., Jos. T.....148
Durakool, Inc.....218
Durant Mfg. Co.....153
Electric Controller & Mfg. Co.....142
Electric Storage Battery Co.....99
Electric Valve & Mfg. Co.....245
Elwell-Parker Electric Co.....143
Emerson Engineers.....245
Engrg & Construction Div. of Koppers Co. .....insert between 218 and 219
Fairbanks Co.....128
Fairbanks, Morse & Co...insert, 175, 176
Farval Corporation.....127
Faultless Caster Corp.....170
Fedders Mfg. Co.....228
Findex Systems, Inc.....245
Finnell System, Inc.....224

Page

Fiske Brothers Refining Co.....101
Foxboro Co.....243
Frigidaire Div. G-M. Sales Corp....212
General Electric Company....14, 15, 225
G. E. Co. (Incandescent Lamp Div.) 222
G. E. Co. (Merchandise Div.).....10, 181
G. E. Vapor Lamp Co.....198, 235
Gifford-Wood Co.....40
Gilmer Co., L. H.....insert, 213, 214
Goodrich Company, B. F.....3, 250
Goodyear Tire & Rubber Co.....231
Goulds Pumps, Inc.....124
Graton and Knight Co.....168, 169
Graybar Electric Company.....7
Grinnell Company.....183
Gulf Refining Company.....33
Hamilton Mfg. Co.....239
Harnischfeger Corporation.....191
Hartzell Propeller Fan Co.....146
Houghton & Co., E. F.....187
Hyatt Roller Bearing Co.....5
Independent Pneumatic Tool Co.....39
Industrial Brownhoist Corp.....184
Industrial Controller Div. of Square D 3rd Cover
Inland Steel Co.....136
International Harvester Co.....151
Iron Fireman Mfg. Co.....18, 19
Johns-Manville, Inc.....6, 205
Johnson Bronze Co.....234
Johnson Gas Appliance Co.....153
Jones & Laughlin Steel Corp.....161
Keasbey & Mattison Co.....129
Kidde & Company, Walter.....159
Koppers Company insert between 218 and 219
Koppers Coal Company insert between 218 and 219
Koppers-Rheolaveur Co. insert between 218 and 219
Leeds & Northrup Co.....163
Leipzig Trade Fair, Inc.....218
Lewis, G. B.....245
Lincoln Electric Co.....154
Lincoln Engineering Co.....173
Link-Belt Company.....4
Logan Co., Inc.....11
Lucas & Son, J. L.....245
Lux Fire Extinguishers.....159
Lyon Metal Products, Inc.....44, 45
Manhattan Rubber Mfg. Div. Raybestos-Manhattan, Inc.....113
Maple Flooring Mfrs. Assn.....41
Mason-Neilan Regulator Co.....178
Master Electric Company.....115
McCaskey Register Company.....8
McGraw-Hill Book Co.....226, 234
Medart Co.....229
Medart Mfg. Co., Fred.....242
Mercury Mfg. Co.....189
Methods Engrg. Council, Inc.....245
Modine Mfg. Co.....192
Mogensen, Allan H.....245
Morse Chain Company.....16, 17
National Lock Washer Co.....232
New Departure Mfg. Company.....52
Nicholson File Co.....131
Norma-Hoffmann Bearings Corp.....220
Norton Company.....188
Osborn Mfg. Company.....9
Page Fence Association.....126
Pangborn Corp.....228
Paraffine Cos.....241
Parks-Cramer Company.....45
Philadelphia Gear Works.....111
Poole, John W.....245
Power Transmission Council.....28, 29
Pure Oil Co.....109
Pyroil Company.....123
Quadrangle Mfg. Co.....242
Quincy Compressor Co.....199
Reading Iron Co.....135
Reliance Electric & Engrg. Co....48, 49

Page

Republic Rubber Co. Div. Lee Rubber & Tire Co.....172
Rhoads & Sons, J. E.....189
Robertson Co., H. H.....190
Rockbestos Products Corp.....209
Ryerson & Son, Inc., Jos. T. insert 157, 158
Sarco Co.....insert 139, 140
Scott Paper Co.....200
Scully Steel Products Co.....221
Searchlight Section.....246, 247
Seneca Wire & Mfg. Co.....128
Service Section.....245
Shafer Bearing Corporation.....117
Shell Union Corp.....107
Shepard Niles Crane & Hoist Corp..236
Sherwin-Williams Co.....167
Signode Steel Strapping Co.....166
Skilsaw, Inc.....149
Smith, Inc., James Campbell.....153
Sonneborn Sons, Inc., L.....237
Spencer Turbine Co.....155
Spring Washer Industry.....123
Square D Company.....3rd Cover
Standard Oil Co. of Indiana..2nd Cover
Standard Pressed Steel Co.....220
Stonhard Co.....226
Stromberg Electric Co.....146
Tar & Chemical Div. of Koppers Co. insert between 218 and 219
Taylor Instrument Cos.....42, 43
Texas Company.....12, 13
Thermoid Rubber Co.....174
Tide Water Associated Oil Co...20, 21
Timken Roller Bearing Co....4th Cover
Trane Company.....227
Trico Fuse Mfg. Co.....206
Union Drawn Steel Co.....185
U. S. Gutta Percha Paint Co....24, 25
U. S. Rubber Co.....164, 165
U. S. Steel Subsidiaries.....182, 221
Veeder-Root, Inc.....236
Victoria Paper Mills Co.....224
Walker-Turner Co.....130
Webb Co., Jervis B.....144
Western Gas Div. of Koppers Co. insert between 218 and 219
Westinghouse Elec. & Mfg. Co..38, 145
Westinghouse Elec. & Mfg. Co. (Lighting Div.).204
Weston Electr. Instrument Corp....210
Wheeler Reflector Co.....147
Wheeling Steel Corp.....105
White Tar Co. of N. J. insert between 218 and 219
Wiley & Sons, Inc., John.....232
Wing Mfg. Co., L. I.....160
Wood Preserving Corp. insert between 218 and 219
Wood's Sons Company, T. B.....155
Yale & Towne Mfg. Co.....47
Young Radiator Co.....232

▼

INDUSTRIAL CONSULTANTS... 245

▼

SEARCHLIGHT SECTION

Classified Advertising

CLASSIFICATION — Page

Buildings.....246
Business Opportunities.....246
Employment Agencies.....246
Employment Service.....246
Positions Vacant.....246
Positions Wanted.....246
Equipment New and Used.....246-247
Atwater Kent Manufacturing Co.....247
Belyea Co., Inc.....247
Chicago Electric Co.....247
Electric Service Co., Inc.....247
Gregory Electric Co.....247
Iron & Steel Products, Inc.....246
Nussbaum & Co.....247
Paterson Mfg. Co.....246

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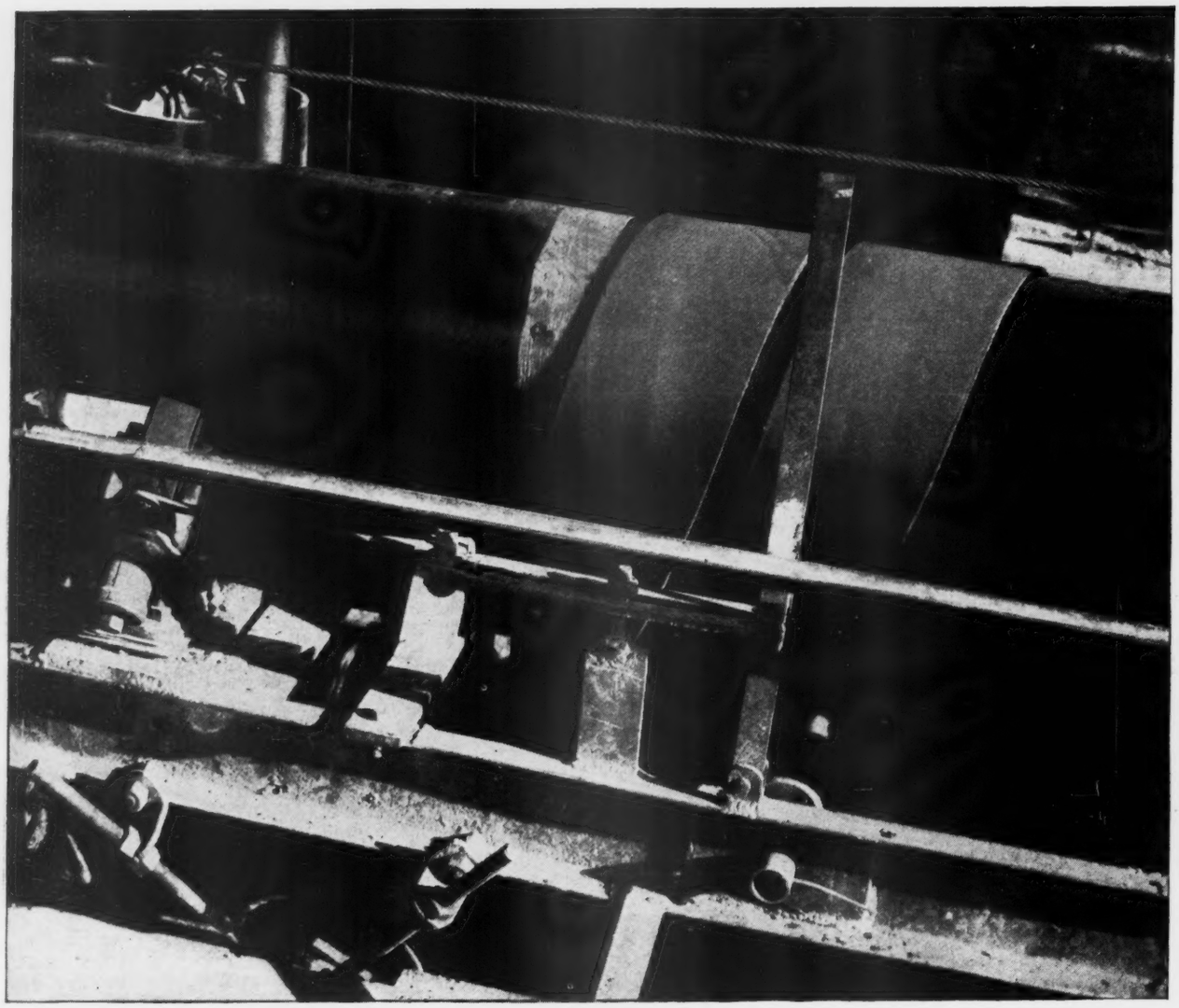


Pipe gets an asphalt bath if belt stands 5000 pounds pull

A typical example of Goodrich improvement in rubber

MOST belts turn pulleys. Loads are heavy, but motion is usually steady and in one direction. The belt above had to twist, stretch and turn, twice around the pipe, also around a complicated pulley system below it, revolving the pipe and pulling it forward at the same time.

The pipe goes through a machine that gives it a coating of asphalt—as long as the belt stands this twisting and turning plus a tension over 5000 pounds. A clever, well-designed installation except for one basic trouble: No belt could be found that would last more than two hours.

Then plant engineers noticed that failure always started at fasteners or splices, decided to try a Goodrich Highflex belt with the newly developed "Plylock" splice, a splice that cannot open at the seams because the seams are under the surface. The first Goodrich belt lasted 14 days—nearly 50 times the best record before.

Technical development makes startling improvements, and Goodrich has applied such development to *every* industrial rubber product. Modern Goodrich conveyor belts carry more tons than belts ever carried before; hose resists abrasive wear, sunlight, oils, chemical actions of the various materials handled; rolls and tank linings are made to last almost indefinitely; new rubber products appear month after month, most of them made to fit customer's special requirements and problems. Somewhere in your own plant the extra quality resulting from Goodrich research in rubber can make a saving *today*. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

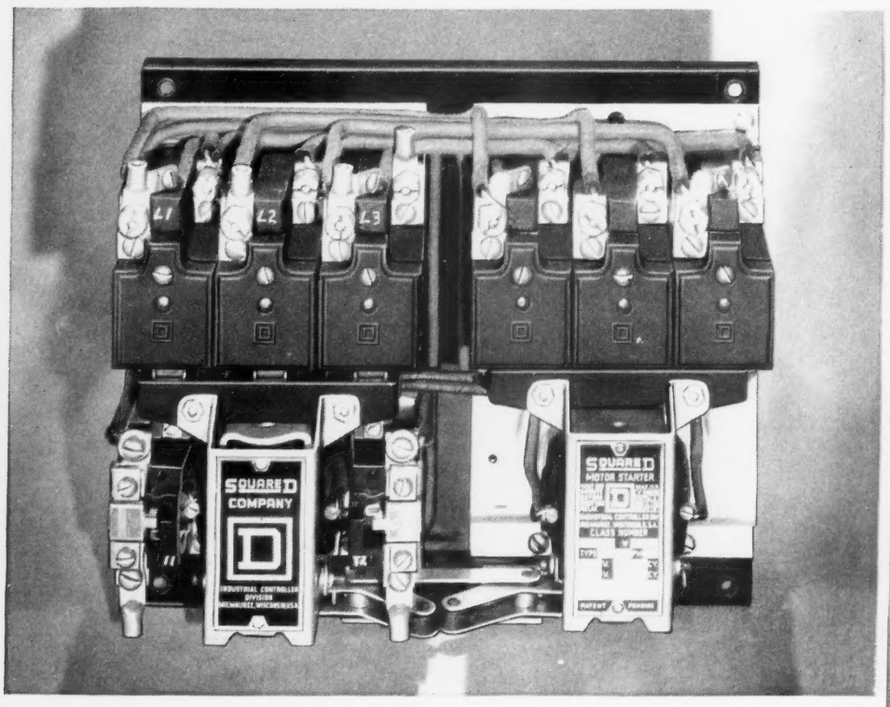
ALL *products problems* IN RUBBER

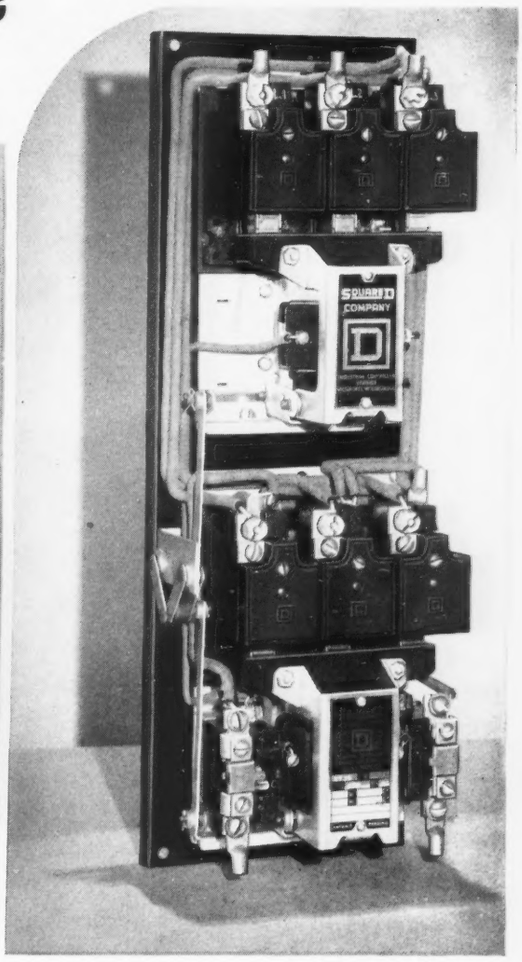
Another story of Goodrich development work appears on page three

New..

SQUARE D Reversing Motor Starters

HORIZONTAL OR VERTICAL MOUNTING FOR BUILT-IN MOTOR CONTROL





Enclosures can be supplied with either type of starter

● The new Class 8736 A. C. reversing motor starters are compact in design and the contactors are mounted either one above the other or side by side, whichever best suits the space requirements.

The starters are mounted on steel panels, which are flanged so as to clear screw heads and can be mounted on a flat surface without the use of spacers or mounting posts. All connections are on the front; no wiring or live parts on the back.

Contactors operate vertically with an "E" type magnet. Silver to silver contacts.

The mechanical interlock positively prevents the closing of both contactors at the same time. The closing of either contactor exerts a pressure to open the other. The interlocks have case-hardened rollers to reduce wear.

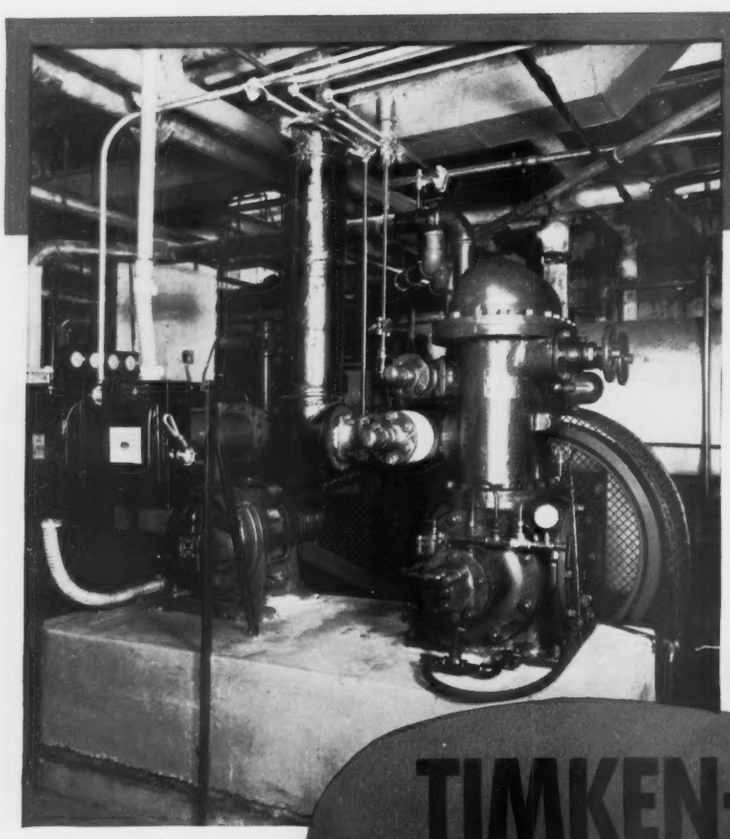
As many as four additional electrical interlocks can be added to each contactor; two can be normally open or three can be normally closed. This permits practically any combination of sequence operation or signals.

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

SQUARE D COMPANY CANADA LTD. TORONTO, ONTARIO

CALL IN A SQUARE D MAN



Timken-equipped Freon Compressor used in connection with York Air Conditioning Equipment installed in the Mayflower Hotel, Washington, D. C.

Mayflower Hotel, Washington, D. C., air conditioned with York Air Conditioning Equipment.

Tapered Roller TIMKEN BEARING EQUIPPED

TIMKEN-EQUIPPED

FOR EFFICIENT, DEPENDABLE OPERATION

The compressor is the heart of any air conditioning or refrigerating system. Efficiency and dependability both are contingent upon the ability of the compressor to perform steadily and constantly.

With the crank shafts mounted on TIMKEN Tapered Roller Bearings the York Ice Machinery Corporation finds that their compressors operate smoother, are economical of power and require less attention for lubrication and maintenance.

Other compressor manufacturers have had the same experience, with the result that "Timken Bearing Equipped" is now associated with leading makes of compressors of all types—air and gas. You will find it pays to insist on TIMKEN Bearings in the new compressor equipment you buy.

8 Budd-built Zephyrs are now rolling on TIMKEN Bearings.

Glide—as you ride a Timken-equipped Train.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; Timken Rock Bits; and Timken Fuel Injection Equipment.

TIMKEN

TAPERED ROLLER BEARINGS